

RECORD OF DECISION

**Northrop Grumman and Naval Weapons Industrial Reserve Plant Sites
Town of Oyster Bay, Nassau County
Site Nos. 1-30-003A & B
March 2001**

SECTION 1: SUMMARY OF THE RECORD OF DECISION

The New York State Department of Environmental Conservation (NYSDEC) in consultation with the New York State Department of Health has selected this remedy to address the significant threat to human health and/or the environment created by the presence of hazardous waste at the Northrop Grumman Bethpage Plant and the Naval Weapons Industrial Reserve Plant-Bethpage (NWIRP), both class 2, inactive hazardous waste disposal sites. In particular, this ROD addresses Operable Unit 2 (OU2), the regional groundwater contaminant plume associated with these sites. As more fully described in Sections 3 and 4 of this document, plant wastes were disposed directly into either drainage sumps, dry wells and/or on the ground surface resulting in the disposal of a number of hazardous wastes, including the volatile organic compounds (VOCs) perchloroethene (PCE) and trichloroethene (TCE), the semi-volatile organic compound (SVOC) polychlorinated bi-phenyls (PCBs) and the inorganics chromium and cadmium at the site. Some of these contaminants have migrated from the points of disposal to surrounding areas, including the soils of these sites and the groundwater beneath and down gradient of Northrop Grumman, NWIRP and the Grumman-Steel Los Plant 2 facilities. Contaminated groundwater originating from the Grumman-Steel Los Plant 2 Site, formerly part of the Northrop Grumman site, now a Class 4 site, is included within the scope of the Northrop Grumman and NWIRP OU2 groundwater remedial action and long-term management plan.

These disposal activities have resulted in the following significant threats to the public health and/or the environment:

- a significant threat to public health associated with contaminated soils, groundwater and drinking water;
- a significant threat to the environment associated with contaminated soils and groundwater;

In order to restore the Northrop Grumman and Naval Weapons Industrial Reserve Plant Site inactive hazardous waste disposal sites to pre-disposal conditions to the extent feasible and authorized by law, but at a minimum to eliminate or mitigate the significant threats to the public health and/or the environment that the hazardous waste disposed at the site has caused, the following remedy was selected:

Groundwater Remedial Program

- continued operation of the on-site containment (ONCT) groundwater extraction and treatment system (formerly known as an Interim Remedial Measure (IRM)) at Northrop Grumman's southern property line;

- an evaluation of the ONCT system to confirm that it is performing effectively;
- mass contaminant removal through groundwater extraction and treatment in an offsite area near the GM 38 monitoring well cluster;
- predesign investigation to determine the optimal groundwater extraction location(s) in the GM 38 offsite treatment area(s);
- long term operation and maintenance of all operating systems, including the ONCT (or former IRM) and the GM 38 area remedy;
- additional groundwater investigation to better define the groundwater contaminant plume and to determine whether additional groundwater remediation is required under this ROD, under an amended OU2 ROD, and/or if an Operable Unit 3 Groundwater RI/FS is warranted;
- long term monitoring of the groundwater including a comprehensive monitoring of plume attenuation;
- the formation of a technical advisory committee (TAC) as deemed necessary by the NYSDEC, to be comprised at a minimum, of the involved Agencies, participating local water districts, Northrop Grumman and the Department of the Navy. The main purpose is to review and provide input on all materials relating to the implementation of the Northrop Grumman and NWIRP OU2 Groundwater remedy.

Public Water Supply Protection Program

- continued public water supply wellhead treatment to meet appropriate drinking water quality performance objectives at wellfields already affected by the groundwater contaminant plume for as long as these affected wellfields are used as community water supply sources;
- public water supply wellhead treatment or comparable alternative measures, as necessary, for wellfields that become affected in the future; and
- long term monitoring of the groundwater contaminant plume including outpost monitoring wells upgradient of potentially affected water supply wells.

During the course of the OU2 remedial investigation certain actions, known as Interim Remedial Measures (IRMs), were undertaken by Northrop Grumman and/or the Department of the Navy in response to the threats identified above. An IRM is conducted at a site when a source of contamination or exposure pathway can be effectively addressed before completion of the RI/FS. A major groundwater IRM undertaken at this site was installation of the onsite containment, or ONCT System, at Northrop Grumman's southern property line. This IRM is described in more detail in Section 4.

Additional response measures taken during the course of the OU2 investigation include installation of wellhead treatment systems at the Bethpage Water District (BWD) Wellfields 4, 5 and 6. This response measure is described in more detail in Section 4.

The selected remedy, discussed in detail in Section 8 of this document, is intended to attain the goals selected for this site in Section 6 of this Record of Decision (ROD), in conformity with applicable standards, criteria, and guidance (SCGs).

SECTION 2: SITE LOCATION AND DESCRIPTION

The Northrop Grumman and NWIRP inactive hazardous waste disposal sites are located in east-central Nassau County, Long Island (see Figures 1 and 2).

The entire Northrop Grumman site was initially more than 600 acres in area, but has been reduced in size through previous remedial activities and confirmatory sampling events. The portions of the former Northrop Grumman site that remain listed in the New York State Registry of Inactive Hazardous Waste Disposal Sites include the southern recharge basins, the NWIRP and the Grumman-Steel Los Plant 2 site (formerly the Grumman Plant 2 facility). The southern recharge basins and the Grumman-Steel Los Plant 2 facility currently total about 35 acres in size. The NWIRP site is approximately 105 acres in size. There are numerous groundwater industrial supply wells and recharge basins at these sites.

The RUCO Polymer site, site No. 1-30-004, (see figure 4) is located to the northwest of the Northrop Grumman Site and west-northwest of the NWIRP. There are other industrial and commercial facilities in the area along with several residential communities. There are several public supply wells within a two-mile radius of the sites.

SECTION 3: SITE HISTORY

3.1: Operational/Disposal History

Northrop Grumman Site No. 1-30-003A

The Grumman Aerospace Corporation was established in the early 1930s at the present site in Bethpage. Several naval aircraft were developed and manufactured at the site. Other activities at the site included the manufacturing of naval amphibious craft and the manufacturing of various satellites, etc. for the National Aeronautics and Space Administration (NASA).

From 1943 to 1949, Grumman disposed of chromic acid wastes directly on the ground or in open seepage basins. In 1949, a chromic acid treatment system was put on-line at Plant 2. In addition to the chromic acid treatment system located at Plant 2, systems for treating phenols, oils, and other organic compounds, and for recovering silver were also used at Plant 2. Since the early 1950s, some of the wastes generated by Grumman were taken to the NWIRP property for treatment or storage before being taken off site by private haulers. These wastes included common organic solvents consisting of chlorinated hydrocarbons. There were several locations on the Grumman site where wastes were stored, treated, or disposed of. Trichloroethene (TCE) was stored in an above ground tank along the northeastern corner of Plant 2. A release of TCE from this tank (or the associated piping system) occurred and was discovered during the Grumman Remedial Investigation.

NWIRP Site No. 1-30-003B:

The NWIRP was established in 1933. The NWIRP is known as a government owned, contractor operated (GOCO) facility. Since its inception, the primary mission for the facility has been the research, prototyping, testing, design engineering, fabrication, and primary assembly of military aircraft.

The facilities at the NWIRP include four plants (No. 3, 5, and 20, used for assembly and prototype testing; and No. 10, which contains a group of quality control laboratories), two warehouse complexes, a salvage storage area, water recharge basins, an industrial wastewater treatment plant, and several smaller support buildings.

The following is a discussion of the waste handling practices at the three identified disposal areas at the NWIRP facility (see Figure 3 or area locations):

Area 1 - Former Drum Marshaling Area

From the early 1950's to 1978, drums containing liquid wastes were stored on a cinder covered area over a cesspool leach field. This leach field may have been used to discharge process wastewater. In 1978, the drum storage area was moved a few yards to the south to a 100- by 100-foot concrete pad. This pad did not have a cover or berms around it. In 1982, the drum storage area was moved to Area 3.

Various solvents were stored at Area 1. Cadmium and cyanide wastes were also stored in this area from the early 1950's through 1974. Approximately 200 to 300 drums were stored at these locations at any given time. Reportedly, all drums of waste which were stored at these areas were taken offsite by a private contractor for treatment and disposal.

Area 2 - Recharge Basin Area

Prior to 1984, some Plant 3 production-line rinse waters were discharged in the three on-site recharge basins. These waters were directly exposed to chemicals used in the industrial processes (rinsing of manufactured parts). Only non-contact cooling water has been discharged into these basins since 1984. The source of this non-contact cooling water has been on-site production wells.

On at least one occasion (1956), hexavalent chromium was detected in the water in the recharge basins at concentrations in excess of allowable limits. This matter was discovered and handled by the Nassau County Department of Health.

Adjacent to and west of the recharge basins are the former sludge drying beds. Sludge from the Plant 2 Industrial Waste Treatment Plant (part of the Grumman Site as described above) was dewatered in these beds before being disposed of off-site.

Area 3 - Salvage Storage Area

The NWIRP salvage storage area is located to the west of Area 2. This area has been used for the storage of fixtures, tools, and metallic wastes such as aluminum and titanium scraps, since the early-1950's.

Located within the salvage storage area was a 100- by 100 foot area that was used for the storage of drummed waste. This 100 by 100-foot area was reportedly covered with coal ash cinders. Halogenated and non-halogenated waste solvents were stored in this area from the early-1950's through 1969. The exact location of this drum storage area is not known. Since 1982, drums have been stored in a covered area with a concrete pad and berms.

Grumman-Steel Los Plant 2, Site No. 1-30-003C (Groundwater Contamination):

In 1994, the Grumman Aerospace Corporation was purchased by the Northrop Corporation and became known as the Northrop Grumman Corporation. In December 1996, Northrop Grumman sold Plant 2 and the surrounding land to the Steel Los III Corporation (Steel Los). Steel Los refurbished the Plant 2 complex and now leases the former Plant 2 as commercial real estate.

The Plant 2 facility, listed as site No. 1-30-003C on the New York State Registry of Inactive Hazardous Waste Sites, was originally part of Site 1-30-003A, the Northrop Grumman Site. Now known as the Grumman Steel Los site, this site was addressed by the Operable Unit One (OU1) soils remedy for the Northrop Grumman Site. The OU1 ROD deferred groundwater contamination issues to this OU2 groundwater remedy. The Grumman Steel Los Site is now a class 4 site, and long term monitoring will be required, in part due to residual cadmium and chromium contamination beneath the site. A deed restriction for the property has been filed to minimize the potential for exposure to residual contamination and to minimize the potential for groundwater leaching of residual contaminants.

OXY Hooker Ruco, Site No. 1-30-004 (Not the Subject of this ROD):

The RUCO Polymer site (see figure 4) was originally the Rubber Corporation of America. The Hooker Chemical Corporation (now the Occidental Chemical Corporation, also known as OCC or OXY) purchased the Rubber Corporation of America (RUCO) in 1965. The RUCO plant was sold to the employees in 1982. The site is now a subsidiary of the Sybron Corporation under the name RUCO Chemical Corporation (RUCO Site). OXY has retained the environmental liability for the past disposal practices.

Between 1956 and 1975, industrial process wastewater and storm water runoff from the facility was discharged to six (6) on-site recharge basins or sumps. This wastewater contained chlorinated hydrocarbons including PCE, TCE and vinyl chloride monomer (VCM), as well as other organic and inorganic wastes. These waste waters have contributed to the contamination of the Bethpage regional aquifer upgradient and beneath the Northrop Grumman, NWIRP and Grumman-Steel Los facilities. The OXY Hooker Ruco Site is listed on the National Priorities List (NPL) of the United States Environmental Protection Agency (USEPA). A separate remedial program is being carried out for the Ruco site under the oversight of the USEPA. Therefore, the Ruco site is not a direct focus of this ROD except inasmuch as it may affect the effectiveness of groundwater remedies (see for example Item D in Section 7.1).

3.2: Remedial History

Northrop Grumman and Grumman Steel Los Plant 2:

Grumman was reportedly notified in December 1947 that a sample collected from Well No. 3 of the Central Park Water District (predecessor of the Bethpage Water District) contained chromium at a concentration of 1.4 parts per million (ppm). As a result, the District's well No.s 1, 2 and 3, located on Jackson Avenue near the train station, were permanently closed. Eventually Grumman Aerospace reimbursed the District for these wells. Grumman installed a chromic acid treatment system for its Plant 2 waste waters. This system went on-line in 1949.

Odor and taste problems were discovered in water pumped from some of Grumman's on-site production wells in 1973. Several investigations into the source(s) of this problem were conducted from 1973 through the early 1980's. It was ultimately determined that these problems were due to chlorinated hydrocarbons in the groundwater.

The Northrop Grumman site was added to the New York State Department of Environmental Conservation's Registry of Inactive Hazardous Waste Disposal Sites in New York State (Registry) in 1983. At the time, the NWIRP-Bethpage site was considered part of the Northrop Grumman site. The site was initially listed as a Class 2a site because there was insufficient data to assign it a classification set forth in the Environmental Conservation Law (ECL).

Based on a subsequent review of existing data, the Grumman site was reclassified to a Class 2 site by the NYSDEC in December 1987. A Class 2 site is a site which poses a significant threat to human health and/or the environment, and for which action is required.

Northrop Grumman conducted a remedial investigation (RI) on site between October 1989 and September 1994. As a result of this investigation, two source areas were identified. The NYSDEC also divided the remedial programs at the Northrop Grumman Site and the NWIRP site into two operable units; site soils and the regional groundwater. An operable unit is designated to represent a portion of the site remedy which for technical or administrative reasons can be addressed separately to eliminate or mitigate a release, threat of release or exposure pathway resulting from contamination at a site.

The purpose of the Feasibility Studies on the Northrop Grumman and NWIRP sites was to develop and evaluate remedial alternatives for remediating the soils contamination defined during the RI(s). A Record of Decision (ROD) for operable unit one (OU1) for the Northrop Grumman site was issued in March 1995 and for the NWIRP site in July 1995.

A soil vapor extraction system was installed adjacent to a former storage tank that was used to store trichloroethene (TCE) at Plant 2. This system was shut down for a short period of time and was used to remediate a small area of contamination (perchloroethene or PCE) at Plant 15. The Plant 15 source area has been adequately remediated. The adequacy of the Plant 2 remediation will be determined after confirmatory sampling.

In addition to the hazardous waste remediation program, the parts and parcels of the former Grumman Aerospace facility have been regulated under the Resource, Conservation and Recovery Act, (RCRA), or active facility permitting program. Under the RCRA program, other remedial measures (sometimes called corrective

actions), have been implemented by the NYSDECs RCRA program (also discussed in section 4) and under the USEPA's underground injection control (UIC) program.

Contaminated soil and dry well sediments, at known or potential source areas (such as various Northrop Grumman and NWIRP facilities), have been or are being addressed under OU 1 and/or appropriate RCRA and UIC closure programs.

Certain specific areas of the former Plant 2, or Steel Los property, have elevated levels of chromium and cadmium. The Steel Los Corporation opted to remove only the hazardous waste levels of contamination and then restrict access to the remainder of the soils with contamination above NYSDEC soil cleanup objectives. These areas are well below ground surface and have been deed restricted. The restriction requires maintenance of a cap or cover system at the site and special measures prior to and during ground intrusive activities. These provisions are intended to minimize the potential for leaching of residual contaminants and to minimize the potential for exposure to subsurface contaminants, respectively. The Steel Los property has been reclassified to a class 4, which means the remedial actions are in place and proper long term operation, maintenance and monitoring is required. Cadmium and chromium are included as analytes in the long term hydro-geologic monitoring plan.

NWIRP

An Initial Assessment Study was conducted at the NWIRP-Bethpage site in 1986. Based upon the results of this study, it was concluded that three areas at the site posed a threat to human health or the environment. A description of the Northrop Grumman and NWIRP sites is presented in Section 3.1. In March 1993, NYSDEC listed the NWIRP as a separate Class 2 Registry Site, distinct from the Northrop Grumman Site. The NWIRP site was excluded from the 1990 Northrop Grumman RI/FS Order on Consent and therefore, a separate investigation was required.

An RI/FS was conducted at the site from August 1991 through July 1995. The purpose of the RI was to determine the nature and extent of the contamination that was found during the Initial Assessment Study. The NWIRP ROD called for addressing soils contamination at the three areas of concern. The NWIRP remedies called for the excavation and removal of specific areas of PCB and solvent contamination and the reduction of soils to be excavated by the implementation of a soil vapor extraction system in conjunction with shallow groundwater remediation through air sparging.

OXY Hooker RUCO

The RUCO Site is broken into three operable units. OU 1 addresses site soils and adjacent groundwater, OU 2 addresses soils associated with a particular recharge basin, and OU 3 addresses the offsite migration of groundwater contaminated with VOCs including vinyl chloride and tentatively identified compounds, or TICs, that generally fall into the category of semi-volatile organic compounds (SVOCs). The USEPA issued a Record of Decision for the offsite groundwater contamination, or Operable Unit 3 (OU3) in September 2000. The USEPA OU 3 ROD remedy includes enhanced natural attenuation and long term monitoring of a concentrated groundwater contaminant plume known as "the vinyl chloride subplume" that is immediately northwest of the Northrop Grumman site. The USEPA OU 3 ROD remedy recognizes the importance of

preventing the vinyl chloride subplume from adversely affecting the performance and regulatory compliance of Northrop Grumman's groundwater remedial systems and requires that RUCO will take necessary steps to protect the Northrop Grumman groundwater treatment system.

3.3: Enforcement History

Grumman

Grumman entered into a Consent Order with the NYSDEC on October 25, 1990 in which Grumman agreed to conduct a RI/FS at the Northrop Grumman site.

NWIRP

The United States Navy has undertaken their environmental studies pursuant to the Navy's Installation Restoration Program. The State of New York provided oversight of the work conducted by the Navy pursuant to a Memorandum of Understanding between the State and the Department of Defense.

Resource Conservation and Recovery Act

The purpose of this ROD is to set forth the groundwater remedial program and the public water supply protection program for the Northrop Grumman and NWIRP Sites as set forth in 6 NYCRR Part 375, "Inactive Hazardous Waste Disposal Sites." These two sites are also regulated under 6 NYCRR Part 373, commonly known as the Resource, Conservation and Recovery Act, (RCRA) program. This is the permitting and ultimately the closure process for active facilities that store, generate, and treat hazardous wastes over a certain quantity as defined under this regulation. The RCRA program as promulgated under NYSDEC regulations is authorized by the USEPA to issue RCRA permits.

SECTION 4: SITE CONTAMINATION

To evaluate the contamination present at the site and to evaluate alternatives to address the significant threat to human health and the environment posed by the presence of hazardous waste, the Northrop Grumman Corporation and the Navy have conducted two area-wide remedial investigation and feasibility studies (RI/FS's) and a smaller focused RI/FS on the Navy property.

The RCRA program is addressing the contaminated soils beneath the Northrop Grumman and NWIRP buildings. In addition, both Grumman and the Navy are working towards completing the remediation of large capacity underground fuel oil tanks that historically leaked. All the tanks have been removed and residual contaminants in these areas are being remediated under the NYSDEC Division of Environmental Remediation Underground Storage Tanks (UST) program.

4.1: Summary of the Remedial Investigation

The purpose of the RI was to define the nature and extent of any soil and groundwater contamination resulting from previous activities at the Site. The RI was conducted in two phases. The first phase was conducted between February, 1991 and October, 1991 and the second phase between August 1992 and September 1993. For the Northrop Grumman property, a report entitled "Remedial Investigation Report, Grumman Aerospace Corporation, Bethpage, New York, May 1994," has been prepared. For the NWIRP, two reports entitled "Final Remedial Investigation Report NWIRP, May 1992," and "Phase 2 Remedial Investigation Report, NWIRP, October 1993," describe the field activities and findings of the RIs in detail.

The first two FSs were for soils remedies covered under OU 1 RODs with the Navy and Northrop Grumman. The Focused RI/FS, being conducted by Northrop Grumman, is still ongoing for the two remaining PCB contaminated dry wells at the NWIRP. An additional FS, which is the subject of this PRAP, was prepared for offsite groundwater issues.

The following investigatory techniques were used in order to achieve the goals for the RIs:

- Soil gas surveys were conducted in various locations throughout the site in order to locate potential areas which could be sources of groundwater contamination.
- Soil samples were collected in various locations throughout the site to confirm the results of the soil gas surveys and to identify source areas that could not initially be located using the soil gas survey technique.
- Groundwater samples were collected from monitoring wells that were installed as part of the two Remedial Investigations and by other organizations (such as the United States Geological Survey).

To determine whether the groundwater is contaminated at levels of concern, the RI analytical data were compared to environmental Standards, Criteria, and Guidance values (SCGs). Groundwater, drinking water and surface water SCGs identified for the Northrop Grumman and NWIRP Sites are based on NYSDEC Ambient Water Quality Standards and Guidance Values and Part 5 of the New York State Sanitary Code. Based on the RI results, in comparison to the SCGs and potential public health and environmental exposure routes, the groundwater requires remediation. The RI results are summarized below. More complete information can be found in the RI Report on file in the document repositories.

Chemical concentrations are reported in parts per billion (ppb) or parts per million (ppm). For comparison purposes, where applicable, SCGs are provided for each medium.

4.1.1: Site Geology and Hydrogeology

The sites are underlain by five geologic/hydrogeologic formations (descending from ground surface):

- Pleistocene deposits (Upper Glacial Aquifer) consisting of various sands and gravels intermixed with discontinuous low permeability clay lenses, approximately 100 feet thick
- Magothy Formation (Magothy Aquifer) consisting of various sands and gravels varying in thickness interlaced with low permeability confining layers,
- Raritan Clay Formation
- Lloyd Sand Formation (Lloyd Aquifer)
- Bedrock

The Upper Glacial, Magothy and Lloyd aquifers are all important formations for the purposes of this ROD. Groundwater from the Upper Glacial aquifer in this area eventually percolates to the Magothy aquifer. The Magothy Aquifer is the aquifer that is utilized the most as a source of drinking water.

4.1.2: Regional Groundwater Study

The investigation of onsite and offsite groundwater contamination associated with the Northrop Grumman and NWIRP Sites is referred to as the regional groundwater study. The information gathered was used to screen alternatives in the Operable Unit 2 (OU 2) Groundwater Feasibility Study. The groundwater plume is estimated to extend over an area of more than 2,000 acres and to a depth of approximately 700 feet. Due to the magnitude of this contamination and the multiple sources of the contamination, a regional remedy for addressing the groundwater contamination was required. The process of developing a regional remedy began in October 1994 and originally included Northrop Grumman, the NWIRP and the RUCO Sites. Subsequently, in September 1998, the involved Agencies determined that the RUCO Site would be most appropriately addressed separately under the USEPA's RI/FS program for that site.

4.1.3: Nature of Contamination

As described in the RI report, numerous soil, soil gas, groundwater and sediment samples were collected at the site to characterize the nature and extent of contamination. The main categories of contaminants which exceed their SCGs are inorganics (metals), volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides and polychlorinated biphenyls (PCBs).

A summary of the groundwater analytical data generated during the RIs is presented in Table 1. Summaries of the soils analytical data are presented in the RODs for onsite soils that are referenced in Section 3.2. It is recognized that residual soil contaminants such as chromium and cadmium beneath the Plant 2 property could serve as a source of groundwater contamination in the future. Although this ROD addresses groundwater contaminants, this relationship between soils and groundwater is recognized throughout the ROD.

The sites are located in an area of deep aquifer recharge. Precipitation that percolates through the soil and enters the aquifer system travels vertically down through the aquifers thus replenishing the water that is pumped for potable uses. Pollutants in the unsaturated soils and upper reaches of the aquifer system also migrate downward with infiltrating water.

The primary groundwater contaminants are chlorinated VOCs which were either used and disposed of at the sites or are breakdown products of these chemicals. These compounds are:

- perchloroethene (PCE)
- trichloroethene (TCE)
- dichloroethenes (DCE)
- vinyl chloride
- 1,1,1-trichloroethane

Inorganic analytes (metals), specifically arsenic, cadmium and chromium were detected in groundwater samples that were collected at the sites. The arsenic, cadmium, and chromium were detected at concentrations greater than the corresponding standards, though only in a small number of on-site monitoring wells.

4.1.4: Extent of Contamination

Groundwater

By current estimates, the groundwater plumes emanating from the two sites total more than 2,000 acres in area and are over 700 feet deep in places. An estimate of the areal extent of the plume, based on 1993 groundwater data, is presented on Figure 5. Recent groundwater Data from the Navy vertical profile borings indicates that Northrop Grumman contamination has migrated southward beyond the Hempstead Turnpike.

On-Site Groundwater Plume

The highest concentrations of VOCs in groundwater were detected in samples collected from on-site wells. The most contaminated on-site well was the intermediate depth well of the HN-24 well cluster (see Figure 6), located on the southwest corner of the Navy property, in which TCE was detected at a concentration of 58,000 ppb (the drinking water standard is 5 ppb). An attempt to isolate the source of this contamination was unsuccessful. Concentrations greater than 1,000 ppb have been detected in some of Grumman's and the Navy's production wells. Consistently high concentrations of VOCs have been detected in Grumman production well GP-1 for some time, and a treatment system has been installed to treat the water that is pumped from that well (see Section 4.2).

Off-Site Groundwater Plume

To date, the plume(s) emanating from the sites have impacted or threaten three public water supply wellfields operated by the Bethpage Water District (see Figure 5). There are treatment systems in place at each of these three impacted or threatened wellfields (see section 4.2). The water that is distributed to the community is tested on a monthly basis to ensure that the drinking water standards promulgated by the NYSDOH are met. In addition, the Bethpage Water District has a policy of providing its consumers with drinking water that contains no detectable concentrations of site-related contaminants. Given the proximity of the contaminants to the Bethpage Water District (BWD) well fields, nine (9) outpost or sentry wells were installed upgradient of the water supplies. These wells have been sampled on a quarterly basis since March 1995. The purpose of this quarterly sampling is to provide the BWD with the data necessary to ensure that the existing treatment systems are adequate to treat the level of contaminants that may impact their public supply wells. The data are also used to make decisions about the need for groundwater remediation.

Based upon a review of the sentry well data, there is an area surrounding monitoring well cluster GM-38 that contains high concentrations, in excess of 1,000 ppb, of site-related contamination. The outpost wells will continue to be monitored to determine the groundwater concentrations of these site-related contaminants.

Soil

The Northrop Grumman and NWIRP OU1 RODs dealt with soil contamination outside the areas of the site buildings at the Northrop Grumman and NWIRP sites. Contaminated soils beneath the site buildings are being addressed by the RCRA program, or active facilities permitting program. This is being accomplished by sampling, excavation and offsite disposal of contaminated soils.

Sediments

Sediments in some of the onsite recharge basins contained elevated levels of inorganics. All sediments that were removed from the recharge basins were characterized and sent offsite for disposal. The closure of the onsite storm drains was through the USEPA underground injection control (UIC) program.

4.1.5: Development of a Computer Groundwater Model

A groundwater computer model was developed as a tool for developing and evaluating remedial alternatives for addressing the groundwater contamination. The study area that is encompassed in the model is 24.1 square miles in area (see Figure 8). The model was constructed in order to simulate groundwater flow throughout the entire thickness of the Upper Glacial and Magothy aquifers. A detailed description of the model is presented in the Northrop Grumman Groundwater Feasibility Study Report, Appendix B, dated October, 2000. Copies of this report are on file at the document repositories listed on Page 2 of this document.

4.2: Interim Remedial Measures

An Interim Remedial Measure (IRM) is conducted at a site when a source of contamination or exposure pathway can be effectively addressed before completion of the RI/FS. Two major groundwater response actions, the ONCT IRM and the provision of wellhead treatment for impacted public supply wells, have been implemented over the past seven years and have been incorporated into the selected remedy for these sites.

On-Site Containment IRM

The On-Site Containment (ONCT) IRM was installed by Northrop Grumman. It was realized during the early stages of the feasibility study that one of the components of the final remedy for addressing the groundwater contamination was the containment of the portions of the plume(s) that are still beneath the sites (i.e. - prevent further migration of contaminants off site to the extent practicable). Pumping at the onsite production wells had helped contain much of the contamination onsite. However, as Northrop Grumman and the Navy began closing down their Bethpage operations, many of the on-site production wells were slated to be removed from service. Therefore, it was decided to implement a specific groundwater containment remedy as an Interim Remedial Measure (IRM) in advance of making a decision regarding the final groundwater remedy. This system went on-line in November 1997.

As designed, the ONCT IRM system consists of four extraction wells; one of which was pre-existing (GP-1), and three others that were installed in 1996-97 (see Figure 7). The bulk of the contaminant removal is predicted to occur in wells ONCT-1 and GP-1, with lesser amounts of contaminants extracted from wells ONCT-2 and ONCT-3. The combined pumping rate for wells GP-1, ONCT-1, ONCT-2, and ONCT-3 is 3,375 gallons per minute.

The groundwater that is pumped from these wells is treated to remove VOC contaminants prior to being recharged back into the aquifer via on-site recharge basins. This combination of pumping, treating and recharge are the factors by which the on-site plumes will be contained ("hydraulic containment"). Eventually, most of the Northrop Grumman production (GP) wells that added additional pumping will be closed and only the ONCT system, consisting of GP-1 and ONCT extraction wells 1, 2 and 3 will be left in place. The closure of most of the production wells was incorporated into the design of the containment system.

Protection of the Bethpage Water District Public Supply Wells

Treatment systems have been installed at the three currently operated and impacted or threatened public supply wellfields operated by the BWD (see also section 4.1.2). The treatment systems at BWD Plants 4, 5 and 6 were installed by the district. Plant 4 and 6 costs were reimbursed by Grumman. The treatment system at BWD Plant 5 was reimbursed by the U.S. Navy as specified in the May 1995 OU 1 ROD for the NWIRP-Bethpage site.

4.3: Summary of Human Exposure Pathways:

This section describes the types of human exposures that may present added health risks to persons at or around the site. A more detailed discussion of the health risks can be found in Section 5 of the RI report entitled, "Contaminant Fate and Transport."

An exposure pathway is the manner by which an individual may come in contact with a contaminant. The five elements of an exposure pathway are; 1) the source of contamination; 2) the environmental media and transport mechanisms; 3) the point of exposure; 4) the route of exposure; and 5) the receptor population. These elements of an exposure pathway may be based on past, present, or future events.

Human exposure pathways, relative to this operable unit (groundwater), known to presently exist or that have historically existed at the site include:

- direct contact with (dermal absorption), ingestion of, and inhalation of vapor from contaminated onsite groundwater; and
- direct contact with (dermal absorption), ingestion of, and inhalation associated with contaminated groundwater through residential or commercial use.

Human exposures could occur by ingesting or coming into direct contact with untreated, contaminated groundwater pumped from a water supply well. Additionally, inhalation of VOCs could occur if contaminated water is used for cooking, cleaning or bathing. Several BWD public water supply wells were impacted by contamination from the Site. Water from the affected municipal wells is either no longer used or treated to remove the contaminants prior to distribution to the community. Routine monitoring of the treated water supplies has demonstrated the effectiveness of these treatment systems in preventing exposures to groundwater contaminants.

There are no known private drinking water wells in use within the contaminated aquifer area. The nearest down gradient private well, a non-contact cooling water well at a hospital, was tested in 1998 and found to be free of site-related contaminants.

In summary, while human exposures to contaminated groundwater may have occurred in the past, there are no known exposures that are presently occurring due to the implementation of appropriate response measures.

It should be noted that exposures to contaminated soil, dry well sediments, and groundwater at known or potential source areas (such as various Northrop Grumman and NWIRP facilities) have been or are being addressed under OU1 and/or appropriate RCA and UIC closure programs.

4.4: Summary of Environmental Exposure Pathways

There are no surface water bodies or other environmentally sensitive areas within a two-mile radius of the sites. Therefore, it was concluded that there is a negligible risk to wildlife in the area from the disposal of hazardous wastes at the sites.

SECTION 5: ENFORCEMENT STATUS

Grumman entered into a Consent Order with the NYSDEC on October 25, 1990 in which Grumman agreed to conduct a RI/FS at the Northrop Grumman site.

Resource Conservation and Recovery Act

The purpose of this ROD is to set forth the groundwater remedial program for the Northrop Grumman and NWIRP Sites as set forth in 6 NYCRR Part 375, "Inactive Hazardous Waste Disposal Sites." These two sites are also regulated under 6 NYCRR Part 373, commonly known as the Resource, Conservation and Recovery Act, (RCRA) program. This is the permitting and ultimately the closure process for active facilities that store, generate, and treat hazardous wastes over a certain quantity as defined under this regulation. The RCRA program as promulgated under NYSDEC regulations is authorized by the USEPA to issue RCRA permits.

Potentially Responsible Parties (PRPs) are those who may be legally liable for contamination at a site. This may include past or present owners and operators, waste generators, and haulers. The NYSDEC and the Northrop Grumman Corporation (Grumman Aerospace) entered into a Consent Order on October 25, 1990. The Order obligated Northrop Grumman to implement an RI/FS.

NWIRP

The United States Navy has undertaken their environmental studies pursuant to the Navy's Installation Restoration Program. The State of New York provided oversight of the work conducted by the Navy pursuant to a Memorandum of Understanding (MOU) between the State and the Department of Defense. The Department of the Navy entered into a Memorandum of Understanding (MOU) with the NYSDEC in 1993. The MOU brought the NYSDEC into the Department of the Navy's Installation Restoration (IR) program. Upon issuance of the Record of Decision for Operable Unit 2 (OU2) the NYSDEC will approach the Northrop Grumman Corporation and the Department of the Navy to implement the selected remedy under an Order on Consent and a Federal Facility Site Remediation Agreement respectively.

SECTION 6: SUMMARY OF THE REMEDIATION GOALS

Goals for the remedial program have been established through the remedy selection process stated in 6 NYCRR Part 375-1.10. The overall remedial goal is to meet all Standards, Criteria and Guidance (SCGs) and be protective of human health and the environment. At a minimum, the remedy selected must eliminate or mitigate all significant threats to public health and/or the environment presented by the hazardous waste disposed at the site through the proper application of scientific and engineering principles.

The goals selected for this site are:

- Eliminate, to the extent practicable, site-related contaminants from the affected public water supplies and to prevent, to the extent practicable, the future contamination of public water supplies through the implementation of the offsite groundwater remediation.
- Eliminate, to the extent practicable, exposures to contaminated groundwater.
- Eliminate, to the extent practicable, off-site migration of contaminated groundwater and, where practicable, to restore the groundwater to pre-disposal conditions.
- Eliminate, to the extent practicable, the offsite migration of soils contamination entering the groundwater.
- Eliminate, to the extent practicable, exceedances of applicable environmental quality standards related to releases of contaminants to the waters of the state.

SECTION 7: SUMMARY OF THE EVALUATION OF ALTERNATIVES

The selected remedy must be protective of human health and the environment, be cost effective, comply with other statutory laws and utilize permanent solutions, Alternative technologies or resource recovery technologies to the maximum extent practicable. Potential remedial alternatives for the Northrop Grumman and the NWIRP sites were identified, screened and evaluated in the Operable Unit 2 (OU2) Report entitled "Groundwater Feasibility Study, Northrop Grumman, Bethpage."

The On Site Containment System (ONCT) and the wellhead treatment for the BWD Wells are response actions that have already been implemented and that will be incorporated into the selected remedy for this site. All of the alternatives contained in the OU2 Groundwater ROD include the continued operation, maintenance and monitoring (OM&M) of the ONCT system and the BWD wellhead treatment.

A summary of the detailed analysis follows. As presented below, the time to implement reflects only the time required to put the remedy in place, and does not include the time required to design the remedy, procure contracts for design and construction or to negotiate with responsible parties for implementation of the remedy.

7.1: Description of Alternatives

The following potential response actions are intended to address contaminated groundwater associated with the site and to protect affected or potentially affected public water supply systems.

For Alternatives 1 thru 8, the following Items A through F, are included in Some or All of the Alternatives:

A. On-Site Plume Containment (ONCT), Treatment, and Discharge to On-Site Recharge Basins via the On-going ONCT System (formerly called the ONCT IRM):

Under this component of each Alternative, the existing ONCT System will continue operating. The pumping rate from the ONCT system (See Figure 9) would continue at the approximate rate of 3,375 gallons per minute.

The water would be recharged into the recharge basins located adjacent to Plant 5 and to the southern recharge basins. Costs for this option do not include the already completed design and construction but do include operation and maintenance.

B. Long Term Operation and Maintenance of VOC Removal Systems At Three Off-Site Bethpage Public Water Supply Well Fields:

A long-term agreement is being renegotiated between the BWD and Northrop Grumman to pay for the operation and maintenance of the treatment systems at BWD well fields 4, and 6. This agreement would be required to be effective for at least 30 years or until the treatment at a public supply well(s) is no longer necessary to meet appropriate remedial goals, or until BWD decides to shut down any given supply well. The Department of the Navy entered into a cash out agreement with the BWD for the installation, permanent operation and maintenance of a treatment system at BWD wellfield 5.

The Bethpage Water District has a policy of providing its consumers with drinking water that contains no detectable concentrations of VOC contaminants. As of the date of this ROD, Northrop Grumman through its agreement with the BWD for Plants 4 and 6 and the Department of the Navy for Plant 5 have paid for VOC removal treatment that is sufficient to meet this District policy.

C. Long-Term Operation Maintenance and Monitoring (OM&M) That Includes Comprehensive Monitoring of Plume Attenuation, Outpost Groundwater Monitoring with a Public Water Supply Protection Contingency, and Long-Term Operation and Maintenance of All Operating Treatment Systems On-site.

A long-term operation, maintenance and monitoring (OM&M) program would be designed and implemented and is included with each Alternative. This OM&M plan includes the installation of at least twenty new monitoring wells and specific vertical profile borings. The OM&M plan includes a specific task for verifying the Grumman Steel Los Plant 2 and the NWIRP source area contamination does not pass beyond the ONCT system.

Installation of vertical profile borings and/or monitoring wells in offsite areas would be included in the outpost monitoring, remedial design, and plume tracking programs. The OM&M vertical profile boring program has been expanded to cover areas south of Hempstead Turnpike. The goals for this OM&M program would be to monitor the groundwater plume(s) both on-site and off-site, monitor the effectiveness of the groundwater remedy or remedies and determine if wellhead treatment is necessary. Comprehensive monitoring of plume attenuation would also be used with respect to the fate and transport of site contamination. This component would also contain operation and maintenance provisions for all treatment systems.

The goals for the long term monitoring program would be to:

- monitor the groundwater plume(s) both on-site and off-site; and
- monitor the effectiveness of the groundwater remedy.

Samples will be collected on a quarterly, semi-annual or annual basis from a monitoring well network (approximately 20 - 40 wells). The specific sampling locations and the specific analyses would be based upon periodic reviews under the ongoing long term OM&M program. In addition, water level data would be collected

on a regular basis. These results would be evaluated by means of periodic updating of the computer groundwater model that has been developed (see Section 4.1.3) for this site.

All the alternatives contain a contingency for public water supply wellhead treatment or comparable alternative measures. The treatment or alternative measures will be sufficient to meet the appropriate remedial goals for this project (see item F below). Outpost monitoring would indicate if VOC concentrations in the groundwater would potentially threaten a public supply well. A wellhead treatment system would be designed and installed or comparable alternative water supply measures would be implemented if outpost monitoring well data, as determined by the NYSDEC and State and County Health Departments, indicate that treatment of a public supply well or provision of an alternative water source is necessary to protect public health from exposure to site-related contamination. The determination of appropriate water supply protection measures will be made with input from the affected water district(s).

The ongoing ONCT system would require a long term operation and maintenance plan to be submitted to the Department for review, acceptance and periodic updates. The public supply wellhead treatment systems currently in place will also require an operation and maintenance plan both of which would be for the minimum of the thirty year CERCLA time frame or until the treatment systems are no longer required.

D. Vinyl Chloride Contingency Plan

The feasibility study does not include specific treatment for vinyl chloride. The RUCO site is upgradient of the Northrop Grumman Site and historically upgradient of the NWIRP Site due to large scale pumping by Northrop Grumman. The RUCO site discharged vinyl chloride, other chlorinated solvents and other organic compounds directly into the aquifer through on-site recharge basins. The USEPA has selected a remedy for the RUCO site vinyl chloride subplume. The existing ONCT system was not designed to treat vinyl chloride, a VOC that requires unique methods of treatment to meet stringent air discharge limits. Thus, the NYSDEC directed Northrop Grumman to develop a contingency treatment plan. The USEPA OU 3 ROD remedy includes enhanced natural attenuation and long term monitoring of the vinyl chloride subplume. The USEPA OU 3 ROD remedy recognizes the importance of preventing the vinyl chloride subplume from adversely affecting the performance and regulatory compliance of Northrop Grumman's groundwater remedial systems. Vinyl chloride was recently detected in Northrop production well GP-3, suggesting continued migration of the vinyl chloride subplume. Northrop Grumman has notified the USEPA and OXY that the vinyl chloride treatment contingency plan must now be invoked.

E. Offsite GM 38 Area Remedy:

This offsite groundwater extraction and treatment remedy would be located in the monitoring well GM38 area. This remedial technology would address elevated concentrations of total volatile organic compounds (TVOCs) in groundwater because deep groundwater at the GM-38 well area has been identified as an off-site "hotspot". This process option would be operated as a mass removal option to prevent further degradation of the aquifer. The modeling data from the OU 2 Groundwater FS indicates 7,000 pounds of the contaminant mass could be removed at this location.

Capital Cost:	\$ 4,390,000
Annual O&M Cost:	\$ 220,000
Present Worth:	\$ 6,673,000

F. Northrop Grumman and the Department of the Navy Implementation of "Non-Detect" Policy for Affected Public Water Supplies:

The State of New York, under its State Superfund Program, must ensure that all remedies selected for the remediation of inactive hazardous waste sites are protective of public health and the environment. With respect to the protection of drinking water supplies, the NYSDOH has promulgated Maximum Contaminant Levels (MCLs) for drinking water contaminants in Part 5 of the State Sanitary Code (10 NYCRR Part 5). For the most part, the respective MCLs for the VOC contaminants associated with the Northrop Grumman and Navy sites are 5 micrograms per liter (ug/L or parts per billion (ppb) for water).

Many Water Districts in the vicinity of the OU 2 regional groundwater contaminant plume have policies of providing their consumers with drinking water that contains no detectable concentrations of VOC contaminants. This is sometimes known as a "zero tolerance policy" with respect to VOCs. Northrop Grumman and the Department of the Navy have agreed to establish a goal for any given wellhead treatment or comparable alternative measures for affected drinking water supplies which will provide water that is non-detect using USEPA Method 502.2 to a detection limit of 0.5 micrograms per liter (ug/l) with respect to VOCs for site related contamination as cited in the 2001 Water Quality Monitoring Requirements for Nassau County Public Water Systems. Additional costs to implement this policy relative to the Alternatives considered in the OU 2 FS, if any, fall within the plus fifty and minus thirty percent of CERCLA cost requirements, and therefore will not significantly change the cost estimates for Alternatives 2 through 8.

The Bethpage Water District has a policy that only non-detect water be provided with their treatment system. As of the date of this ROD, Northrop Grumman through its agreement with the Bethpage Water District has reimbursed the District for Plants 4 and 6 and the Department of the Navy has reimbursed BWD for Plant 5 with such treatment technology. It is anticipated that Northrop Grumman and the Department of the Navy will enter into future agreements to implement this policy, as detailed in bullet 9 of section 8 of this ROD, with all water districts affected by site-related contamination.

Alternative 1: No Further Action. A, B, C and D above: This Alternative is the baseline Alternative to which the other alternatives will be compared. Under this Alternative, no additional remedial actions would be incorporated into the existing on-site groundwater IRM which has been installed and is now operating. This Alternative would leave the site in its present condition and would not provide any additional protection to human health or the environment than that already provided. Under this Alternative, no additional remedial actions would be taken and the existing on-site groundwater IRM which has been installed and is now operating would continue to be operated over the next 30 years.

In order to maintain hydraulic containment of the groundwater plume(s), production well GP-1 has been included in the ONCT pump and treatment system design. The GP 1 water would be treated at the IRM treatment system located to the north of Plant 2 and discharged to recharge basins to the west of Plant 2. The ONCT wells are treated by a separate air stripper. The water would be recharged into the southern recharge basins located adjacent to Plant 1.

Capital Cost: \$ 3,670,000

O&M Cost: \$ 1,480,000
Present Worth: \$26,700,000

Alternative 2: A, B, C, D and F above, and HN-24 Area Treatment:

Alternative 2 would add treatment of the HN-24 area on the Navy Plant 3 property. Treatment at the HN-24 area would consist of the use of reactive iron powder injected into the impacted groundwater through a series of injection wells. After injection the reactive iron powder would become immobilized within the soil pore space and begin to react with the contaminants of concern (COCs).

Capital Cost: \$ 4,390,000
O&M Cost: \$ 1,506,000
Present Worth: \$ 28,830,000

Alternative 3: A, B, C, D, E and F above:

Alternative 3 contains the addition of groundwater extraction and treatment system at the GM-38 area. The purpose of the GM-38 groundwater extraction and treatment system would accelerate off-site contaminant mass removal and to restore the off-site portion of the impacted aquifer in the vicinity of BWD Supply Well fields 4, 5 and 6 to remedial action objectives (RAOs) in a shorter time frame than under Alternative 2. The GM-38 area is located approximately 4,500 feet southeast of the Northrop Grumman south recharge basin area, and is defined by the inferred 1 ppm TVOC contour line drawn around Well GM-38D2.

Capital Cost: \$ 8,060,000
O&M Cost: \$ 1,700,500
Present Worth: \$ 33,600,000

Alternative 4: A, B, C, D, E and F above, with HN-24 Area Treatment:

Alternative 4 is the combination of Alternatives 2 and 3. Alternative 4, is undertaken in an attempt to accelerate on-site contaminant mass removal, and restore groundwater quality in these localized areas to RAOs in a shorter time frame than under Alternative 1.

Capital Cost: \$ 9,290,000
O&M Cost: \$ 1,725,500
Present Worth: \$ 35,000,000

Alternative 5: A, B, C, D and F above, and Off-Site Plume Containment, Treatment, and Discharge to Off-Site Storm Sewers:

Alternative 5 would add six new off-site groundwater extraction wells to achieve containment of the full extent of the off-site portion of the TVOC plume. Alternative 5 would provide mass removal from the entire aquifer by the installation of a groundwater extraction and treatment system at the farthest downgradient edge of the plume, to contain the full extent (off-site as well as on-site portions) of the plume. The off-site wells would be installed south of the Northrop Grumman facility and north of Hempstead Turnpike (see Figure 7).

Under Alternative 5, the six new off-site extraction wells (OFCT-1, OFCT-2, OFCT-3, OFCT-4, OFCT-5, and OFCT-6) would be installed. Each off-site well would require an individual treatment system to remove VOCs

from the pumped groundwater. Construction of one central treatment facility, in lieu of six individual systems, would be impractical due to the dense residential development in the area, the substantial distances between proposed off-site extraction well locations, and the large quantity of water to be discharged. It is estimated that the total quantity of water to be pumped from the proposed off-site extraction wells would be 3,635 gpm (equal to 5.2 million gallons per day, or MGD).

Where necessary, monitoring wells would be installed to supplement the existing monitoring well network. The number, location, and depth of wells to be installed will be evaluated during the remedial design phase of the project.

Capital Cost:	\$ 21,390,000
O&M Cost:	\$ 2,700,000
Present Worth:	\$ 62,800,000

Alternative 6: A, B, C, D and F above, Off-Site Plume Containment, Treatment, and Discharge to Off-Site Storm Sewers, and HN-24 Area Treatment:

Alternative 6 contains the elements of Alternative 5 as described above, with the addition of treatment at the HN-24 area, as described above in Alternative 3.

Alternative 6 would provide mass removal from the aquifer through groundwater extraction and treatment at the farthest downgradient edge of the plume, to contain the full extent (both off-site as well as on-site portions) of the plume. Furthermore, Alternative 6 would provide localized groundwater treatment of the HN-24 areas.

Capital Cost:	\$ 22,620,000
O&M Cost:	\$ 3,080,000
Present Worth:	\$ 64,100,000

Alternative 7: A, B, C, D, E and F above, Off-Site Plume Containment, Treatment, and Discharge to Off-Site Storm Sewers:

Alternative 7 contains the elements of Alternative 5 as described above, with the addition of treatment at the GM-38 area, as described in Item E and Alternative 3. Under Alternative 7, Well ONCT-6 would be relocated approximately 500 feet to the northwest and at this location serves the dual purpose of being a local extraction well for the GM-38 area and also being part of the off-site containment well system.

Alternative 7 would provide mass removal from the aquifer through groundwater extraction and treatment. Alternative 7 would also provide groundwater pumping at the farthest down gradient edge of the plume to contain the off-site as well as on-site portions of the plume. In addition, Alternative 7 would provide treatment of the GM-38 area.

Capital Cost:	\$ 21,860,000
O&M Cost:	\$ 3,200,000
Present Worth:	\$ 63,300,000

Alternative 8: A, B, C, D, E and F above, Off-Site Plume Containment, Treatment, and Discharge to Off-Site Storm Sewers and HN-24 Area Treatment:

Alternative 8 is the combination of Alternatives 6 and 7. This Alternative includes all of the remedial process options discussed above.

Capital Cost:	\$ 23,090,000
O&M Cost:	\$ 3,300,000
Present Worth:	\$ 64,700,000

7.2 Evaluation of Alternatives

The criteria used to compare potential remedial alternatives are defined in the regulation that directs the remediation of inactive hazardous waste sites in New York State (6 NYCRR Part 375). For each of the criteria, a brief description is provided, followed by an evaluation of the alternatives against that criterion. A detailed discussion of the evaluation criteria and comparative analysis is included in the Feasibility Study. The HN-24 treatment process will be carried through this evaluation of remedial alternatives even though it has now been deemed unnecessary given the substantial drop in the HN-24 area concentrations.

The first two evaluation criteria are termed threshold criteria and must be satisfied in order for an Alternative to be considered for selection.

1. **Compliance with New York State Standards, Criteria, and Guidance (SCGs).** Compliance with SCGs addresses whether or not a remedy will meet applicable environmental laws, regulations, standards, and guidance.

The most significant SCGs for this ROD are the New York State Water Quality Regulations: Part 5 Drinking Water Standards Title 10, New York Codes Rules and Regulations (10 NYCRR) and NYSDEC Groundwater Standards (6 NYCRR Part 700). Air Quality Regulations (6 NYCRR Part 200 series) are relevant to the air discharges from each groundwater treatment system.

Alternatives 1, 2, 3 and 4 would be compliant with SCGs for the portion of the groundwater plume addressed by each Alternative. Alternatives 5, 6, 7 and 8 would be compliant with SCGs for the entire groundwater plume.

The applicable SCGs for the drinking water are the State's maximum contaminant levels, or MCLs, as specified in Part 5 of the NYS Sanitary Code. These standards are currently being met for treated water at each of the affected public supply well fields in the area. In addition, Northrop Grumman and the Department of the Navy have agreed to a goal for this project, for any given wellhead treatment or comparable alternative implemented due to site-related contamination, to provide water that is non-detect using USEPA Method 502.2 to a detection limit of 0.5 micrograms per liter (ug/l) with respect to VOCs, as cited in the 2001 Water Quality Monitoring Requirements for Nassau County Public Water Systems.

The GM-38 area offsite remedy was added to the feasibility study in order to evaluate the reduction of future contaminant loading to the BWD well fields and any public wellfields downgradient. The groundwater treatment system(s) would be designed to be compliant with the NYSDEC Part 200 Air Quality Regulations.

The air treatment systems for the IRM wells were not designed to treat vinyl chloride and may need to be modified if the vinyl chloride concentrations in the air discharge exceeds state air discharge guidelines. The raw and treated groundwater at the ONCT system, as well as the effluent air stream, would need to be monitored for vinyl chloride. If necessary, a vinyl chloride treatment component would be incorporated into existing treatment system.

The 5 ppb groundwater standard for principle organic contaminants would not be met with respect to full plume interception for alternatives 1 through 4, although natural attenuation should reduce site related contaminant concentrations to below 5 ppb over time.

2. Protection of Human Health and the Environment. This criterion is an overall evaluation of each Alternative's ability to protect public health and the environment.

The contaminant-specific SCGs are currently being met with respect to treated water at the municipal water supplies (specifically the BWD). This is being accomplished via VOC-removal treatment systems that are operating at the wellheads. In addition, Northrop Grumman and the Department of the Navy have agreed to a goal for this project, for any given wellhead treatment or comparable alternative implemented due to site-related contamination, to provide water that contains no detectable concentrations of site-related contaminants.

The plume(s) would be contained along the southern boundary of the Grumman site under each Alternative based upon the computer modeling work that was conducted as part of the Feasibility Study. By containing the portion of the plume(s) that are on-site, the future contaminant load to the downgradient public water supplies would be reduced.

It is anticipated that the extraction and treatment programs for the ONCT system that are incorporated into each of the eight remedial alternatives under consideration here would need to be operated for 30 years or more. At that point there would be residual contamination remaining in the aquifers. The amount of remaining contamination, however, would be incrementally less as additional remedies are implemented under the various alternatives. As contaminant mass loading decreases, the relative importance of reliance upon the wellhead controls also diminishes.

Deep groundwater at the GM-38 well area has been identified as an off-site "hotspot" because concentrations of TVOCs exceed 1,000 ppb (equal to 1 ppm) at that location. The main objective of the GM-38 well area remedy would be to reduce mass contaminant load in the aquifer in the vicinity of three public water supply wellfields. Depending upon placement of the extraction well(s) and system performance, this could also result in reduced loading to the public water supply wells. The remedy would also enhance the long-term natural process of aquifer restoration.

There could be incremental potentials for exposure to VOCs in air posed to downwind populations due to emissions from each additional groundwater treatment plant installed under the eight alternatives. Air pollution and monitoring controls would be implemented as necessary to ensure that the air emissions from these treatment facilities are within the criteria set by the regulatory agencies. Additional engineering controls could be used to further reduce the potential of exposure.

There is a potential for exposure to VOCs in air if the vinyl chloride plume(s) is captured in the ONCT extraction wells. The treatment systems for these wells were not designed to treat vinyl chloride and could result in air effluent concentrations of vinyl chloride that exceed state air discharge guidelines. This potential exposure pathway would be minimized by implementing the vinyl chloride contingency plan.

The next five "primary balancing criteria" are used to compare the positive and negative aspects of each of the remedial strategies.

3. Short-term Effectiveness. The potential short-term adverse impacts of the remedial action upon the community, the workers, and the environment during the construction and/or implementation are evaluated. The length of time needed to achieve the remedial objectives is also estimated and compared against the other alternatives.

There could be short-term impacts to the community if Alternatives 2 through 4 were implemented. The impacts could be dust emissions, VOC emissions and noise during construction activities. Engineering controls would be employed to minimize these impacts.

No short-term impacts to the community or the environment would be expected to occur as the result of implementing Alternative 1. The HN24 area remedy short term impacts would be negligible as the Navy property is now vacant.

The GM38 area remedy would have slightly higher short term impacts. This groundwater extraction and treatment system would be located closer to residential areas. Potential impacts would be addressed under the site specific community health and safety plan through emission control technologies.

For Alternatives 5 through 8, the short term impacts would be much greater than alternatives 1 through 4. The offsite containment (OFCT) system would, in most if not all the locations, be placed on or near residential properties, streets and neighborhoods. In addition, it is envisioned that each OFCT location would require its own treatment system.

4. Long-term Effectiveness and Permanence. This criterion evaluates the long-term effectiveness of the remedial alternatives after implementation. If wastes or treated residuals remain on site after the selected remedy has been implemented, the following items are evaluated: 1) the magnitude of the remaining risks, 2) the adequacy of the controls intended to limit the risk, and 3) the reliability of these controls.

The sources of the groundwater contamination are being addressed as operable units for the Northrop Grumman-Bethpage Facility, NWIRP-Bethpage, and the RUCO Inactive Hazardous Waste Disposal Sites. The long-term effectiveness of each of the source area remedial actions was addressed in the RODs previously issued for these sites.

The time required to remediate the aquifer system is a function of the quantity and location of groundwater that is pumped and treated. It is projected that it would take more than 30 years to remediate the aquifer system

onsite for each of the eight Alternatives. However, the ONCT system will be operated, monitored, and enhanced as necessary to prevent any further migration of onsite contamination into the Bethpage regional aquifer.

The OFCT Containment extraction and treatment system that is incorporated into Alternatives 5 through 8 would likely be operated for 30 years or longer. Based on the groundwater modeling, after 30 years of operation, residual contamination would likely exist onsite at concentrations slightly greater than the current drinking water standards.

The GM 38 area remedy is a hot spot remedy that was evaluated in the FS for 15 years. The long term effectiveness for this remedy would be to potentially reduce the contamination loading to the BWD public supply wells on a permanent basis. Performance results from the ONCT IRM already demonstrate that TVOC concentrations in groundwater immediately down gradient from the ONCT system are diminishing. The GM 38 area remedy would enhance this permanent restoration of the natural resource.

5. Reduction of Toxicity, Mobility or Volume. Preference is given to alternatives that permanently and significantly reduce the toxicity, mobility or volume of the wastes at the site.

Reduction of toxicity, mobility, and volume for the onsite groundwater contamination would be realized by the ONCT groundwater extraction and treatment system for all eight alternatives. These reductions would be achieved as a result of the extraction (reduction of mobility and volume) and treatment (reduction of toxicity) components which are incorporated into the ONCT system.

The greatest reductions in toxicity, mobility and volume would be realized under Alternatives 5 through 8 with the OFCT system. Alternative 8 has the highest reduction in mobility with the HN 24 area treatment, GM 38 area remedy and the ONCT and OFCT systems. Alternative 1 has the least reduction in toxicity, mobility and volume because it targets the on-site contamination only via the ONCT system.

6. Implementability. The technical and administrative feasibility of implementing each Alternative are evaluated. Technical feasibility includes the difficulties associated with the construction and the ability to monitor the effectiveness of the remedy. For administrative feasibility, the availability of the necessary personnel and material is evaluated along with potential difficulties in obtaining specific operating approvals, access for construction, etc.

The HN 24 remedy of alternatives 2, 4, 6 and 8 would be fairly easy to implement technically and administratively. There are several vendors who could supply the treatment technologies which are incorporated into these alternatives. Alternatives 2, 3 and 4 are readily implementable with respect to the GM38 area remedy that would be located near an existing Nassau County recharge basin in an open space area. However, easements would have to be obtained from the municipal and private parties that own the property. Alternative 1 is already in place and therefore is the most easily implementable.

Alternatives 5, 6, 7 and 8 would be substantially more difficult to implement administratively with respect to the OFCT system. Private property would have to be purchased or accessed and potentially, zoning changes would be required in order to construct the off-site extraction wells and treatment plants. The permit-related tasks would be difficult to implement. In addition construction of one central treatment facility, in lieu of six

individual systems, would be impractical due to the dense residential development in the area, the substantial distances between proposed off-site extraction well locations, and the large quantity of water to be discharged.

7. **Cost.** Capital and operation and maintenance costs are estimated for each Alternative and compared on a present worth basis. Although cost is the last balancing criterion evaluated, where two or more alternatives have met the requirements of the remaining criteria, cost effectiveness can be used as the basis for the final decision. The costs for each Alternative are presented in Table 2.

This final criterion is considered a modifying criterion and is taken into account after evaluating those above. It is evaluated after public comments on the PRAP have been received.

8. **Community Acceptance.** Concerns of the community regarding the RI/FS reports and the PRAP have been evaluated. A "Responsiveness Summary" has been prepared that describes public comments received and the manner in which the Department will address the concerns raised.

Members of the community at large, particularly in the BWD, have expressed their concerns about site contamination during the Remedial Advisory Board (RAB) meetings sponsored by the Department of the Navy, at the December 13, 2000 PRAP public meeting and in writing during the public comment period. A number of response actions included in this ROD will address community, local official, water district, and public health concerns. These include: the ONCT system, the GM38 area remedy, the outpost groundwater monitoring program, the public water supply contingency for wellhead treatment or comparable alternative measures, the Northrop Grumman and the Department of the Navy agreement to achieve no detectable concentrations of site contaminants in affected water supply wells, additional groundwater investigation to determine if an Operable Unit 3 is necessary, and the long term OM&M systems. It is noteworthy that the PRAP proposal for granular activated carbon (GAC) polishing at affected public water supply wells has been replaced by a contingency for wellhead treatment or comparable alternative measures, with recognition of Northrop Grumman's and the Department of the Navy's stated agreement to use "non-detect" levels as the design goal for the provision of such treatment or measures. Additionally, the selected remedy has been modified to incorporate groundwater remediation measures into a Groundwater Remedial Program whereas response measures related to public water supplies have been incorporated into a Public Water Supply Protection Program.

SECTION 8: SUMMARY OF THE SELECTED REMEDY

Based upon the results of the RI/FS, supplemental investigative data, the evaluation presented in section 7 and the reasons presented below, the NYSDEC is proposing selecting Alternative 3, as described in detail in this ROD. The selected remedy, Alternative 3, consists of the following Groundwater Remedial Program components: the ongoing ONCT system (formerly known as the IRM), the off-site GM-38 area groundwater extraction and treatment system, a vinyl chloride treatment contingency plan for the ONCT system, long-term groundwater monitoring including monitored natural attenuation, and long-term operation and maintenance of all operating treatment systems onsite and off-site. Additionally, the selected Alternative includes the following Public Water Supply Protection Program components: the operation and maintenance of air strippers for BWD well fields 4, 5 and 6, and preparation of a contingency plan for wellhead treatment or comparable alternative measures for public supply wells not currently affected but that may become affected by site-related VOCs in the future.

The selection of Alternative 3 is based on the evaluation of each of the eight Alternatives developed for this site. It was determined that Alternative 3 will meet standards, criteria and guidance for the containment portion of the groundwater plume remedy, prevent exposure to site related contaminants in the groundwater, actively restore a natural resource (sole source aquifer), and prevent further deterioration of down gradient groundwater conditions. Alternative 3 was also chosen based on the fact that it is not economically or technically feasible to contain and treat all the contaminated groundwater that has migrated from the Northrop Grumman and NWIRP sites to groundwater quality standards.

There is a possibility of site-related contamination impacting additional public water supply wells. These wells will be protected by a long term monitoring program that includes sampling of wells upgradient of the public water supply wells and by a contingency to provide wellhead treatment or comparable alternative measures, if necessary.

The preference to permanently and significantly reduce the toxicity, mobility or volume of VOCs in groundwater is satisfied by the selected remedy since it will reduce the mass of VOCs in the groundwater by recovering, treating and discharging groundwater contaminated by the Northrop Grumman and NWIRP sites plume(s). The remedial goal for attainment of the 5 ppb groundwater standard will be met in the treated aquifer segment, to the extent practicable.

Part of the remedy may address contamination that has not been conclusively attributable to Northrop Grumman and/or the NWIRP. In the same manner, not all of the contamination attributable to Northrop Grumman and the NWIRP will be actively addressed by the selected groundwater remedy. Therefore, the public water supply contingency plan will be necessary to address the potential of future exposure to site-related VOCs.

As more data become available, other PRPs may be identified (for example, the RUCO Site). The USEPA has concluded the RI/FS process for the RUCO OU 3 project and has selected a groundwater remedy for the RUCO Site that will address the additional VOC loading, including vinyl chloride, to the Bethpage regional aquifer.

The estimated present worth cost to implement the remedy proposed in this ROD is \$33,600,000. The cost to construct the remedy is estimated to be \$8,060,000 and the estimated average annual operation and maintenance cost for 30 years is \$1,660,700.

The elements of the selected remedy are as follows:

Groundwater Remedial Program

1. A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and maintenance, and monitoring of the remedial program. Any uncertainties identified during the RI/FS will be resolved.

Since the remedy results in untreated hazardous waste remaining at the site, a long term monitoring program, including comprehensive monitoring of plume attenuation will be instituted. This monitoring will evaluate the effectiveness of the ONCT groundwater extraction and treatment system, monitor the levels of select inorganics (e.g., chromium and cadmium) and volatile organic compound (VOC)

contaminants in the groundwater upgradient and downgradient of the ONCT system, monitor the effectiveness of the offsite component of this remedy and the wellhead treatment systems, and better define and track the offsite groundwater contaminant plume. This combined monitoring effort will allow the effectiveness of this remedy to be monitored and will be a component of the operation, maintenance and monitoring (OM&M) program for the site.

2. Continued operation of the Onsite Containment (ONCT) IRM groundwater extraction system to address the onsite TVOC groundwater contamination emanating from the former and current onsite source areas. This system must be sufficient to intercept the width and depth of the entire TVOC plume migrating from the Northrop Grumman Site.
3. A study to confirm the hydrogeologic effectiveness of the onsite containment (ONCT) system. This will, if necessary, include, but not necessarily be limited to, the installation of any required monitoring wells, piezometric measurements, a groundwater modeling effort and a hydrogeologic report, independent of any quarterly monitoring report on the ONCT system predesign study findings.
4.
 - a. A predesign investigation to determine the optimum location(s) for the GM38 area groundwater extraction well(s). This predesign investigation will derive the data necessary to determine the screen zone of the extraction well(s). In addition, the number of extraction wells will be substantiated and the potential need to cluster these wells will be determined.
 - b. The installation of at least one groundwater extraction well, or comparable remedial technology, at the approximate location of the GM38 area, depicted on Figure 7 and as detailed in the Northrop Grumman OU2 FS, with all necessary piping to install the wells and properly run the discharge to the groundwater treatment systems.
 - c. Utilization an existing storm water collection and groundwater recharge system for discharge of treated groundwater. If one is not available, then a suitable method of system discharge and groundwater recharge will be developed.
 - d. The installation of the necessary air stripping systems or comparable remedial technology designed to remove VOCs from all the extracted groundwater to meet the State Pollutant Discharge Elimination System (SPDES) discharge limitations.
5. The installation of air emission controls, if required, to comply with the NYSDEC air regulations.
6. The long-term operation, maintenance and monitoring (OM&M) of the ONCT and GM-38 area extraction well(s). Monitoring will include the installation and use of upgradient and downgradient groundwater shallow, intermediate, deep and very deep monitoring wells. Testing will be done, at a minimum, on a quarterly basis unless otherwise approved by the NYSDEC, to verify the system performance. Additionally, monitoring of groundwater elevations will be done, initially on a quarterly basis (unless otherwise approved by the NYSDEC) to determine the groundwater capture zone in different seasons, and annually thereafter.

7. A specific investigative task will include current work and potentially include, but is not necessarily limited to, installation of additional groundwater monitoring wells, vertical profile borings (VPBs), and groundwater sampling to determine if there are any other areas of elevated groundwater contamination that warrant additional remediation under OU2 and/or creation of an Operable Unit 3. This task, which includes the recent and ongoing installation of VPBs, will be documented in a report to the NYSDEC. The NYSDEC will then, based on the report, make a final determination.
8. The formation of a technical advisory committee (TAC) as deemed necessary by the NYSDEC, to be comprised at a minimum, of the involved Agencies, participating local water districts, Northrop Grumman and the Department of the Navy. The main purpose is to review and provide input on all materials relating to the implementation of the Northrop Grumman and NWIRP OU2 Groundwater Remedial Program and Public Water Supply Protection Program.

Public Water Supply Protection Program

9. The installation and/or quarterly monitoring for VOCs of outpost monitoring wells installed with respect to potentially affected public and private water supply wells, including BWD well fields 4, 5 and 6. The remedial design will evaluate and determine the best locations for any additional outpost wells required for this program. Outpost monitoring wells will be sampled quarterly.
10. A public water supply contingency plan for the design, construction, operation and maintenance of wellhead treatment systems and/or the evaluation of comparable alternative measures, if necessary. If evaluation of the long term groundwater monitoring or the outpost well data indicates that a public supply well has been or is in imminent danger of being impacted by Northrop Grumman/NWIRP site-related contaminants, then wellhead treatment or comparable alternative measure(s) for the impacted public water supply well(s) will be necessary. This determination will be made by NYSDEC, NYSDOH, and the Nassau County Department of Health in conjunction with the potentially impacted water district. The treatment system or comparable alternative measure(s) to produce potable water will be designed and constructed with input from the affected water district. Alternatively, if Northrop Grumman/NWIRP reaches a cash settlement with an affected Water District, then each settling District will be responsible for its respective monitoring and implementation of, as necessary, wellhead treatment, or comparable alternative measures. Operation and maintenance of all public supply well treatment systems, or comparable alternative measures, will be assumed, at a minimum, to operate for the required 30 year time frame as required by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). At a minimum, the NYSDOH Part 5 drinking water standards will always be met.

Northrop Grumman and the Department of the Navy have agreed to establish a goal for any given wellhead treatment or comparable technology for affected drinking water supplies which will provide water that is non-detect using USEPA Method 502.2 to a detection limit of 0.5 micrograms per liter (ug/l) with respect to VOCs for site related contamination as cited in the 2001 Water Quality Monitoring Requirements for Nassau County Public Water Systems.

11. a. Any repeated detection of 1 ppb or more of Northrop Grumman/NWIRP Site-related contamination in the outpost or long term groundwater monitoring wells upgradient of a public supply well will

"trigger" Northrop Grumman or the Department of the Navy to notify the NYSDEC and the potentially impacted water district and to evaluate the rate of movement of the Northrop Grumman/NWIRP contaminants towards the public supply wells.

b. If VOC concentrations in the outpost well(s) approach or exceed a predetermined, outpost well-specific action level, a minimum of one and a maximum of three confirmatory samples will be collected within 30 days and the results evaluated by the NYSDEC and the State and County Health Departments with input from the affected water district(s). If the NYSDEC's and the Health Departments' evaluation indicates that treatment is necessary, the design and construction phase of the water treatment system(s) or comparable alternative measure will begin.

12. The BWD public supply wells and any other supply wells determined to be impacted or potentially impacted based on the long term OM&M, would be sampled on a monthly basis for total volatile organic compounds.
13. The provision of public water to residential or commercial structures that have private drinking water wells determined to be affected or potentially affected by the offsite migration of the Northrop Grumman and NWIRP groundwater plume(s).

Elements Common to Both Programs

14. A long term operation, maintenance and monitoring plan will be prepared that details all of the specific operation and maintenance of the ONCT and the GM 38 area systems and all the monitoring requirements and contingency aspects of this project.
15. A performance evaluation conducted at least once a year to determine whether the remedial goals and performance objectives of all systems have been or can be achieved, and whether the monitoring should continue.
16. A plan to properly close all monitoring wells associated with the Northrop Grumman and NWIRP sites at such time that the wells are no longer necessary.

SECTION 9: HIGHLIGHTS OF COMMUNITY PARTICIPATION

As part of the remedial investigation process, a number of Citizen Participation activities were undertaken in an effort to inform and educate the public about conditions at the site and the potential remedial alternatives. The following public participation activities were conducted for the site:

- A repository for documents pertaining to the site was established.
- A site mailing list was established which included nearby property owners, local political officials, local media and other interested parties.

- In October 2000, the NYSDEC sent out a mailing the public. NYSDEC also announcing the finalized OU2 feasibility study was available to the public.
- In November 2000, issued a press release and a mailing was sent out to the public, announcing the to address ed the release of the OU2 PRAP.
- In March 2001, a Responsiveness Summary was prepared and made available to the public, to address the comments received during the public comment period for the PRAP.

Table 1
Nature and Extent of Contamination

MEDIUM	CATEGORY	CONTAMINANT OF CONCERN	CONCENTRATION RANGE (ppb)	FREQUENCY of EXCEEDING SCGs	SCGs (ppb)
Groundwater (On-Site Monitoring and production Wells)	Volatile Organic Compounds (VOCs)	Perchloroethene	ND-3,600	39/121	5
		Trichloroethene	ND-58,000	55/121	5
		1,1-Dichloroethene	0.38-620	11/121	5
		1,2-Dichloroethene	ND-3,850	21/121	5
		Vinyl Chloride	ND-6,400	11/121	2
		1,1-Dichloroethane	ND-880	8/121	5
		1,1,1-Trichloroethane	ND-10,000	21/121	5
Groundwater (On-Site Monitoring and production Wells)	Inorganic Analytes (Metals)	arsenic	ND(1)-68	7/82	25
		barium	ND(2)-164	0/82	1,000
		cadmium	ND(1)-130	3/82	10
		chromium	ND(1)-160	4/82	50
		lead	ND(1)-7.2	0/82	25
		mercury	ND(0.2)-1.2	0/82	2
		selenium	ND(1)-4	0/82	10
		silver	ND(1)-6	0/82	50
Groundwater Outpost Monitoring Wells for the BWD September 1997		Perchloroethene	ND(0.5)-10	1/9	5
		Trichloroethene	ND(1)-1,300	5/9	5
		1,1-Dichloroethene	ND(0.5)-5.1	1/9	5
		1,2-Dichlorethene	ND(0.5)-1	0/9	5
		Vinyl Chloride	ND(0.5)-1	0/9	2
		1,1-Dichloroethane	ND(0.5)-12	1/9	5
		1,1,1-Trichloroethane	ND(.5)-7	1/9	5

MEDIUM	CATEGORY	CONTAMINANT OF CONCERN	CONCENTRATION RANGE (ppb)	FREQUENCY of EXCEEDING SCGs/Background	SCG/ Bkgd. (ppb)
Groundwater Long Term Monitoring Data 1997-Present		Trichloroethene	ND-15,000	25/106	5
		Tetrachloroethene	ND-44	11/106	5
		1,1-Dichloroethene	ND-39	3/106	5
		1,2-Dichloroethene	ND-6	3/106	5
		Vinyl Chloride	ND-2,000	3/106	2
		1,1-Dichloroethane	ND-10	3/106	5

Table 2
Remedial Alternative Costs

Remedial Alternative	Capital Cost	Annual O&M	Total Present Worth
1. Alternative 1:	\$3,670,000	\$1,480,000	\$26,700,000
2. Alternative 2:	\$4,390,000	\$1,480,000	\$28,200,000
3. Alternative 3:	\$8,060,000	\$1,700,500	\$33,600,000
4. Alternative 4:	\$9,290,000	\$1,725,400	\$35,000,000
5. Alternative 5:	\$21,390,000	\$2,980,000	\$62,800,000
6. Alternative 6:	\$22,620,000	\$3,080,000	\$64,100,000
7. Alternative 7:	\$21,860,000	\$3,200,000	\$63,300,000
8. Alternative 8:	\$23,090,000	\$3,300,000	\$64,700,000

GLOSSARY OF TERMS

- ARAR:** Applicable or relevant and appropriate requirement.
- BWD:** Bethpage Water District.
- Capital Cost:** Refers to the up front cost of constructing a remedial Alternative.
- CERCLA:** Comprehensive Environmental Response, and Comprehensive Liability Act (USEPA).
- Chromium:** An inorganic element used in various manufacturing processes.
- DCE:** Dichloroethene.
- ECL:** Environmental Conservation Law.
- FS:** Feasibility study.
- GM:** Refers to monitoring wells installed for Northrop Grumman by Geraghty and Miller.
- Groundwater**
- Contours:** Equipotential lines of groundwater elevation above mean sea level.
- Glacial:** Refers the Glacial or shallow aquifer associated with Long Island.
- GOCO:** Government owned, contractor operated facility.
- HN:** Refers to monitoring wells installed for the Navy by Halliburton NUS.
- IRM:** Initial Remedial Measure.
- Magothy:** Refers to the section of the Long Island aquifer below the Glacial and above the Lloyd.
- MPS:** The Main Plant Site, or the former Fairchild Republic Aircraft manufacturing facility.
- MCLs:** Maximum contaminant levels.
- MGD:** Million gallons per day, refers to daily rate of pumping groundwater.
- MNA:** Monitored natural attenuation.
- NASA:** National Aeronautics and Space Administration

ND: Non-detect or below the detection limit of the analytical equipment.

NWIRP: Naval weapons Industrial Reserve Plant.

NYCRR: New York State Codes, Rules and Regulations.

NYSDEC: New York State Department of Environmental Conservation.

NYSDOH: New York State Department of Health.

OFCT: Offsite containment system.

ONCT: Onsite containment system.

O,M&M: Refers to operation, maintenance and monitoring, of remedial alternatives.

OU: Operable unit. Refers to portions of the remedial program divided into sections.

PCB: Poly-chlorinated Bi-phenyl.

PCE: (Perchloroethylene or tetrachloroethylene) A chlorinated, aliphatic organic solvent

Plume: Contaminant dispersion in the groundwater.

POTW: Publicly owned treatment works or sewage treatment plant

PPB: Part per billion. For water samples also termed micrograms per liter (ug/l) and for soil samples termed micrograms per kilogram (ug/kg).

PPM: Part per million. For water samples also termed milligrams per liter (mg/l) and for soil samples termed milligrams per kilogram (mg/kg).

PPMV: Part per million volume, used for air samples.

PRAP: Proposed Remedial Action Plan. This is a document listing the remedy(s) proposed to mitigate the threat of hazardous waste disposal to human health and the environment.

PRP: Potential Responsible Party.

RAOs: Remedial Action Objectives, or the goals established to remedy a site based on findings of the RI (CERCLA).

RCRA: Resource Conservation and Recovery Act.

RI/FS: Remedial Investigation an Feasibility Study.

ROD: Record of Decision.

RUCO: Rubber Corporation of America.

SCGs: Standards, Criteria and guidance.

SVOCs: Semi-volatile organic compounds. Semivolatile Compounds- compounds amenable to analysis by extraction of the sample with an organic solvent. Used synonymously with Base/Neutral/Acid (BNA) compounds. Also, organic compounds with boiling points above 150 degrees Celsius.

TAGM: Technical Assistance and Guidance Memorandum. These guidance documents are used by the NYSDEC.

TCA: (Trichloroethane) A chlorinated aliphatic organic solvent.

TCLP: Toxicity Characteristic Leaching Procedure, is one test used to determine if hazardous waste is present.

TCE: (Trichloroethylene) A chlorinated, aliphatic organic solvent.

TVOC: Total volatile organic compounds.

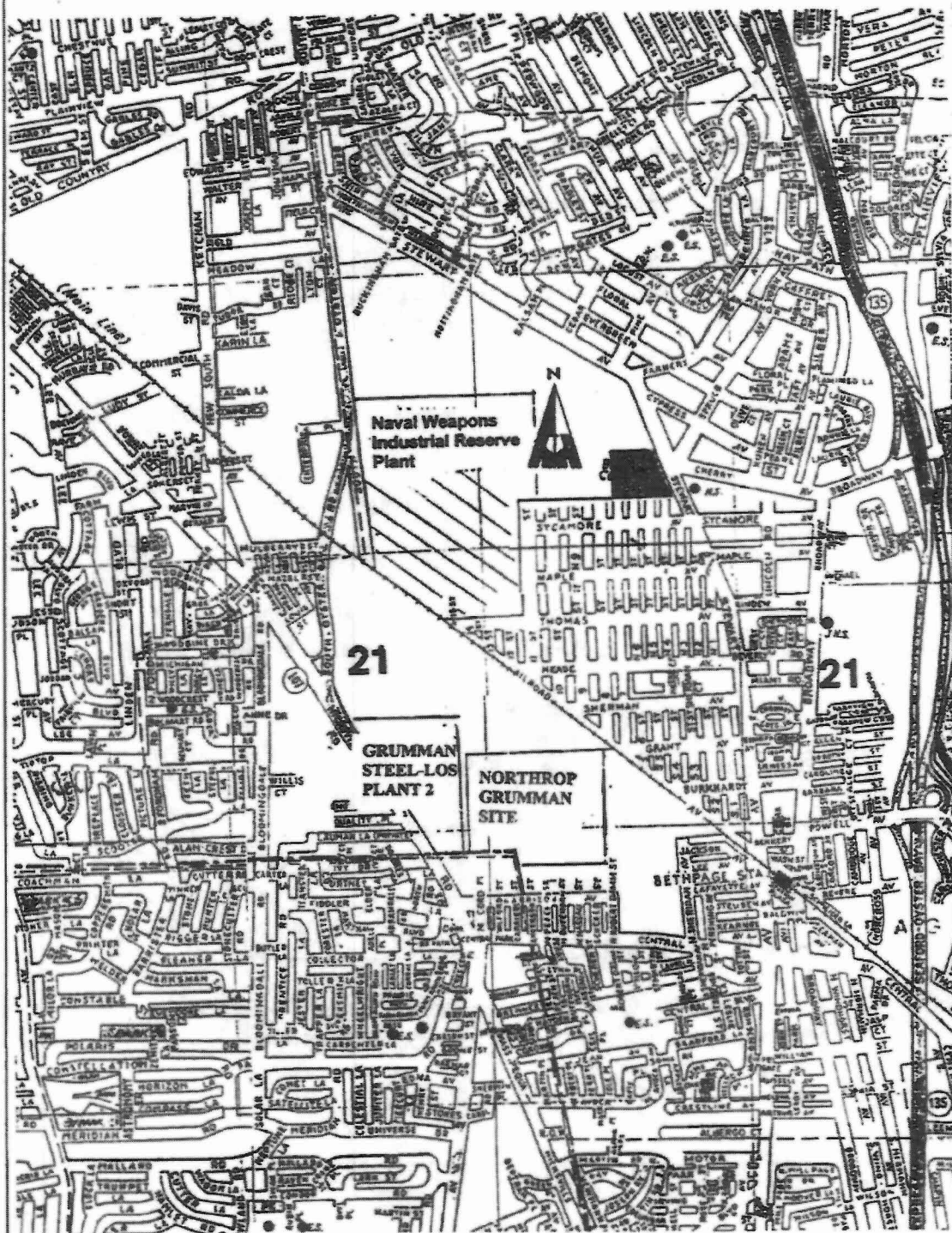
ug/l: Micrograms per liter. See also PPB.

UIC: Underground Injection Control Program.

UST: Underground Storage Tank.

VCM: Vinyl chloride monomer.

VOC: Volatile organic compound. Amenable to identification by gas chromatography analysis. Also, an organic compound that is readily vaporizable at a relatively low temperature.



Northrop Grumman

Figure 1- Area Location Map

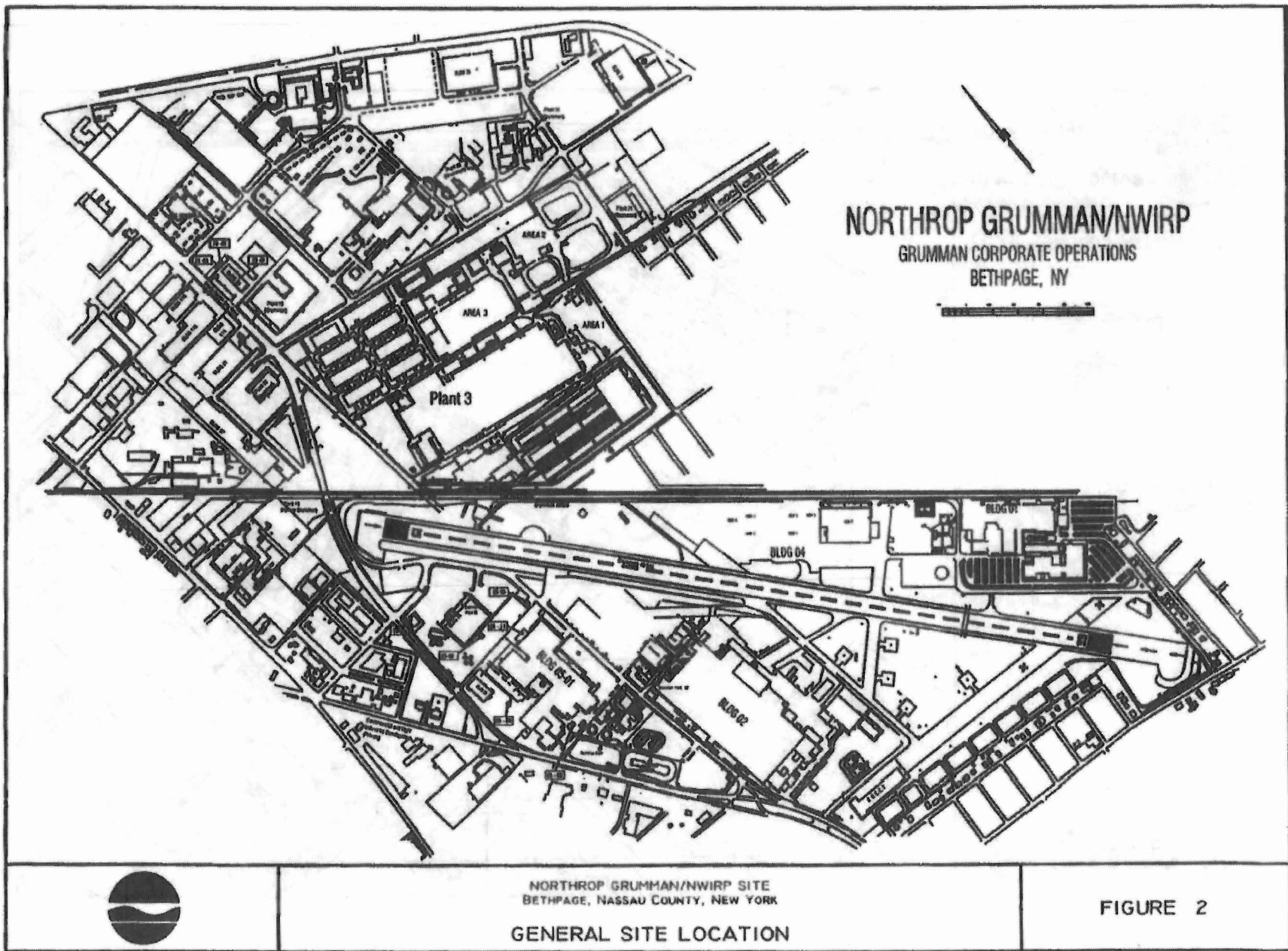
DIVISION OF ENVIRONMENTAL REMEDIATION

REVISED:
DATE: 03/21/00

REVISION:



Town of Oyster Bay, Site Nos 1-30-003A, B and C



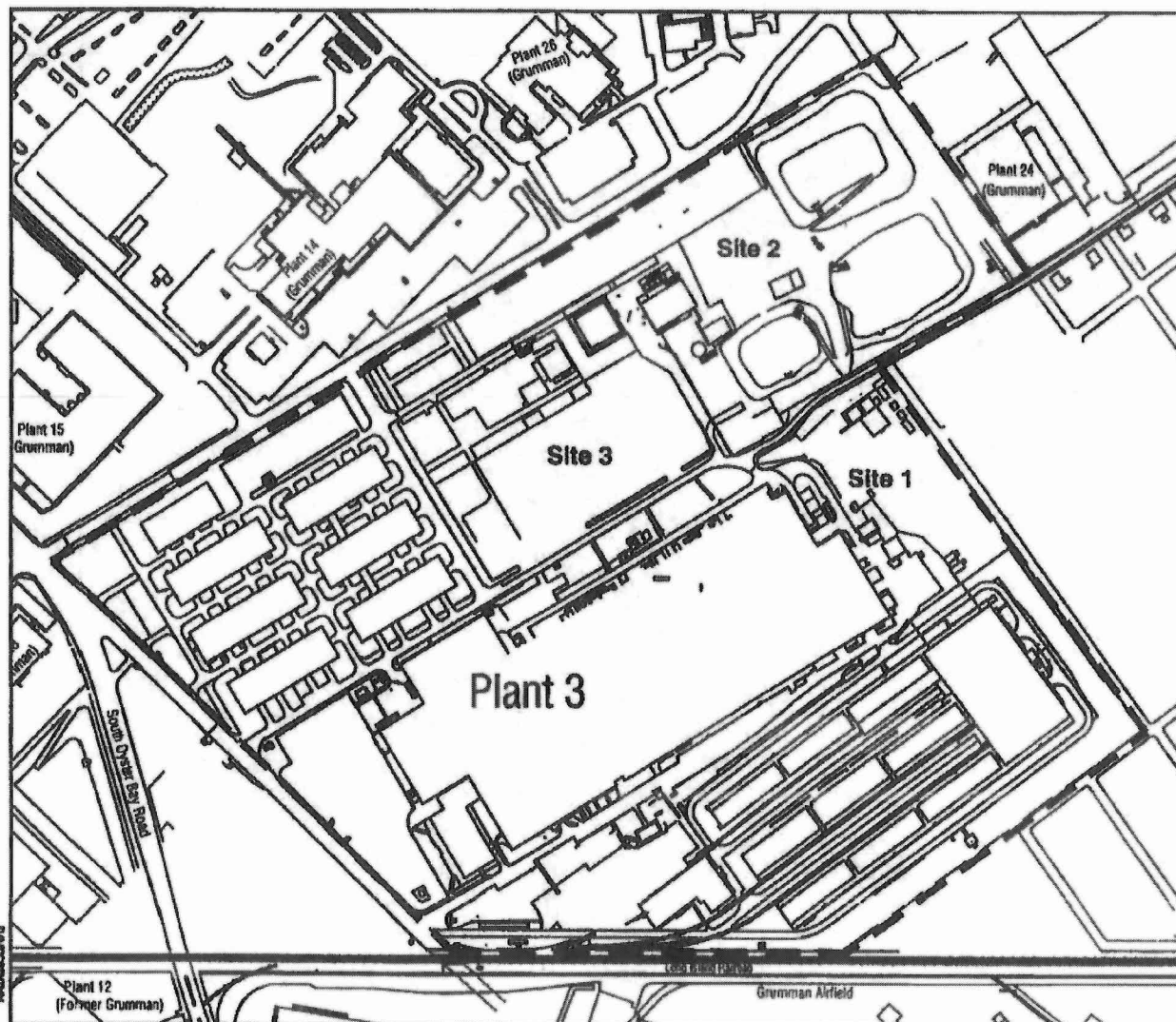


Figure 3

Legend

--- Navy 105 Acre Parcel Boundary



0 100 200 300 400
SCALE IN FEET

April, 2000

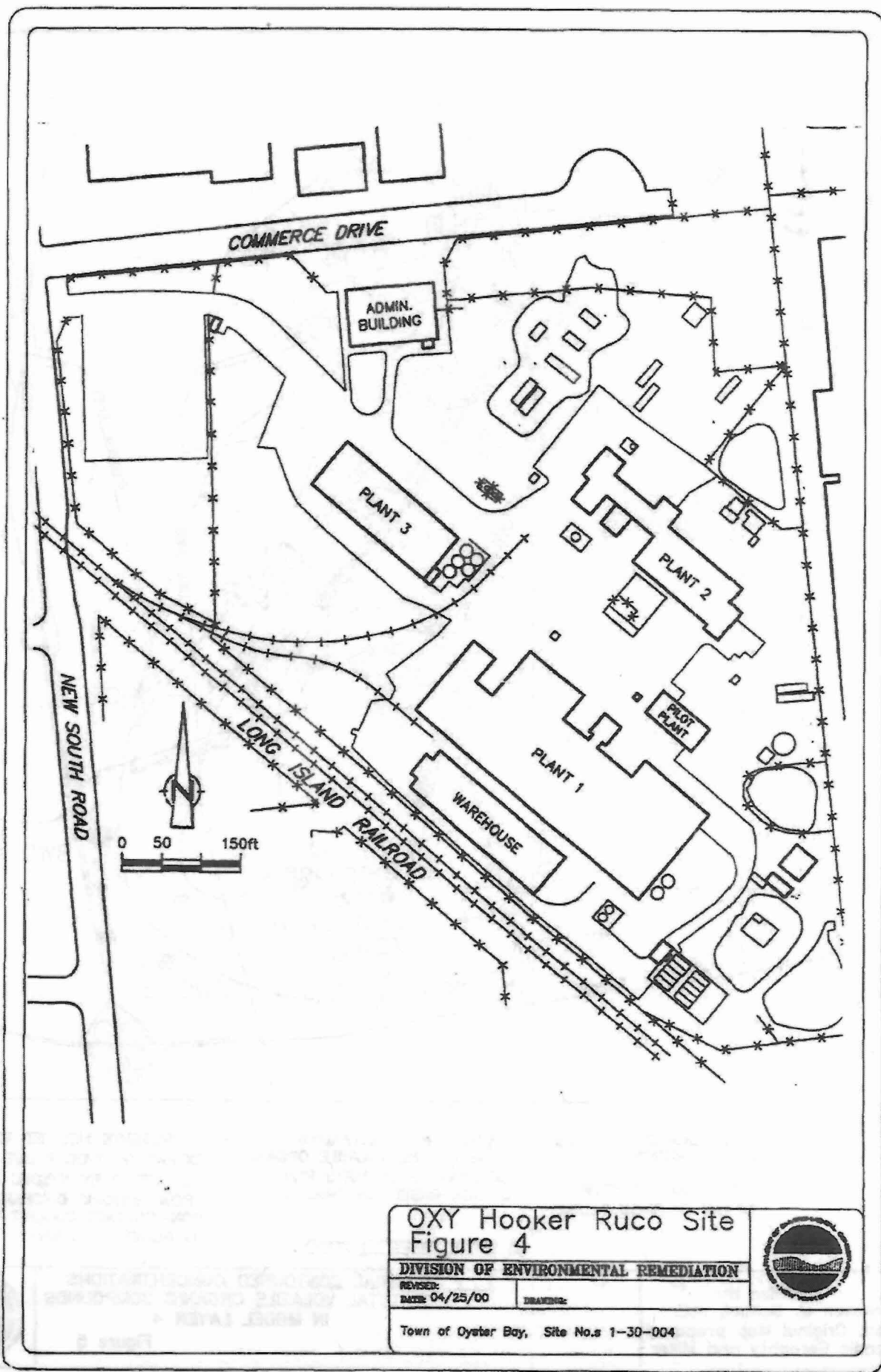
From TetraTech NUS Base Map
Modified by: Steven M. Scharf, P.E.

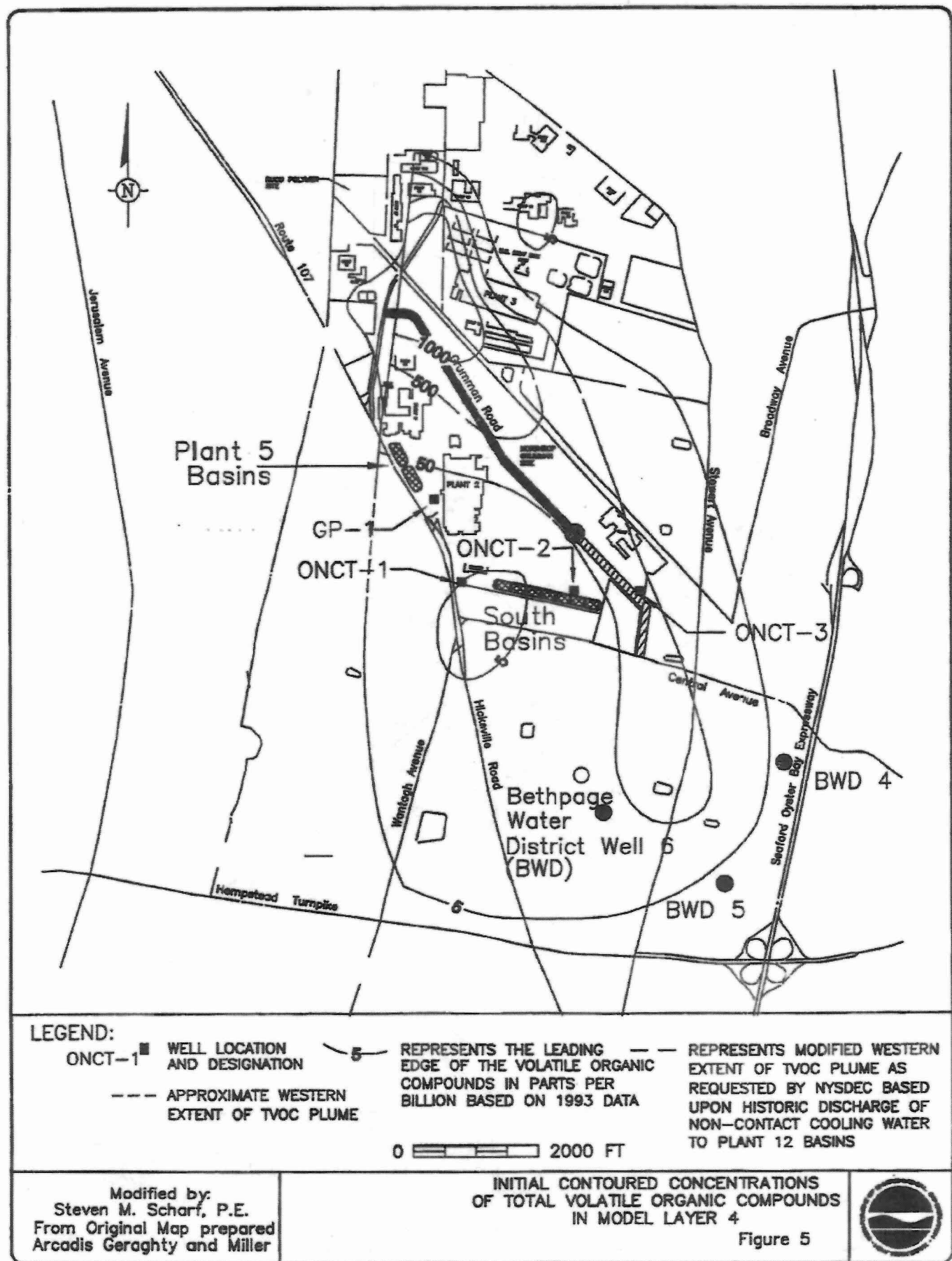
**Naval Weapons
Industrial Reserve
Plant
NWIRP Bethpage**

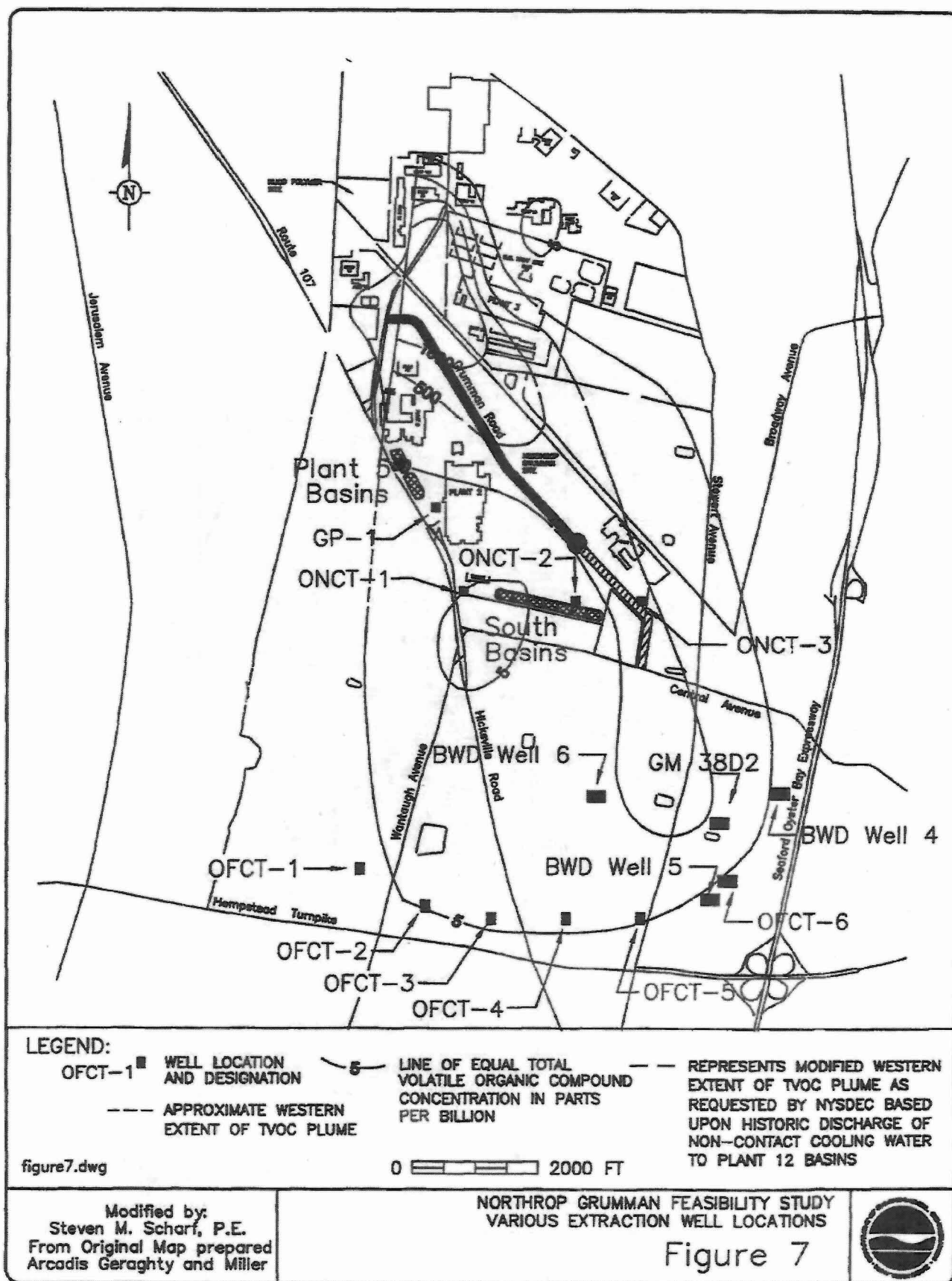
(NWIRP.DWG)

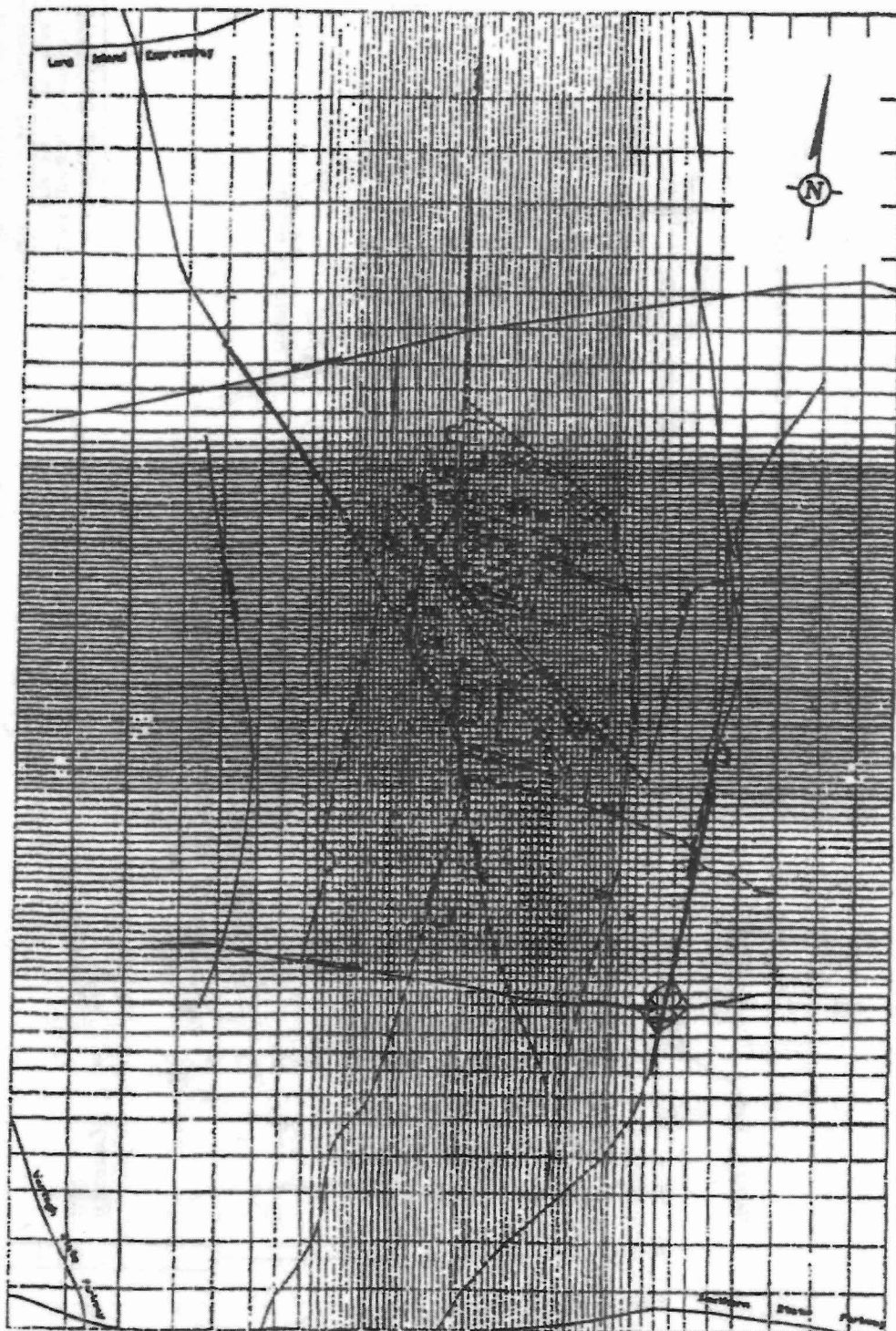
For Estimating Purposes Only, Not To Scale











Groundwater Model Grid
Figure 8

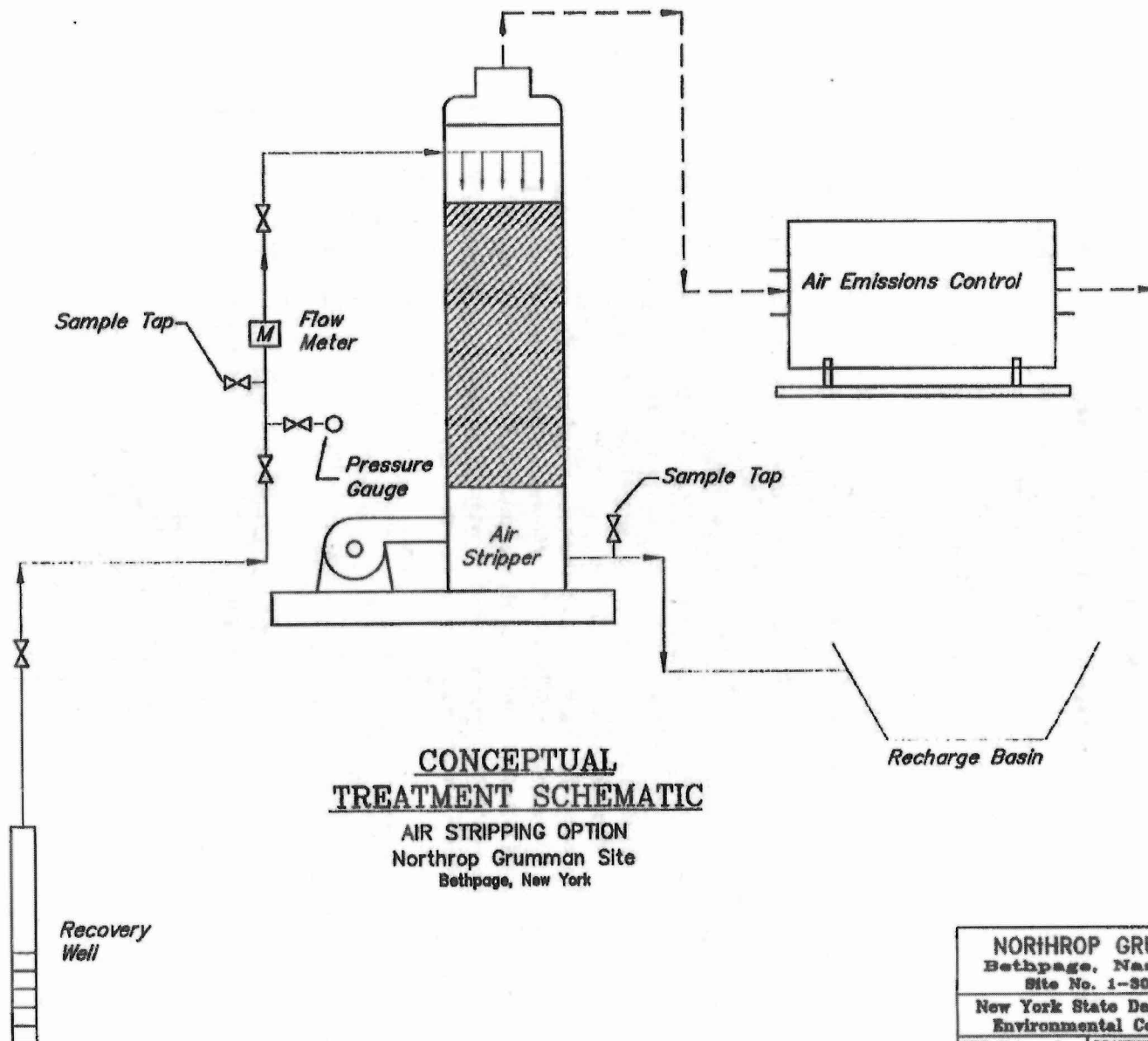
DIVISION OF ENVIRONMENTAL REMEDIATION

REVISION:
DATE: 06/22/00

REVISION:

Northrop Grumman Site





CONCEPTUAL TREATMENT SCHEMATIC

AIR STRIPPING OPTION
Northrop Grumman Site
Bethpage, New York

NORIHROP GRUMMAN SITE Bethpage, Nassau County Site No. 1-90-003A, E, C	
New York State Department of Environmental Conservation	
FILE: Stripper.dwg	DRAWING: Rev 00
GROUNDWATER REMEDIATION SCHEMATIC VIEW	
DATE: 04/26/00	FIGURE 9